



Armed Forces College of Medicine

AFCM

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THE THORACIC WALL

Thoracic cage, Joints& Intercostal Muscles

By

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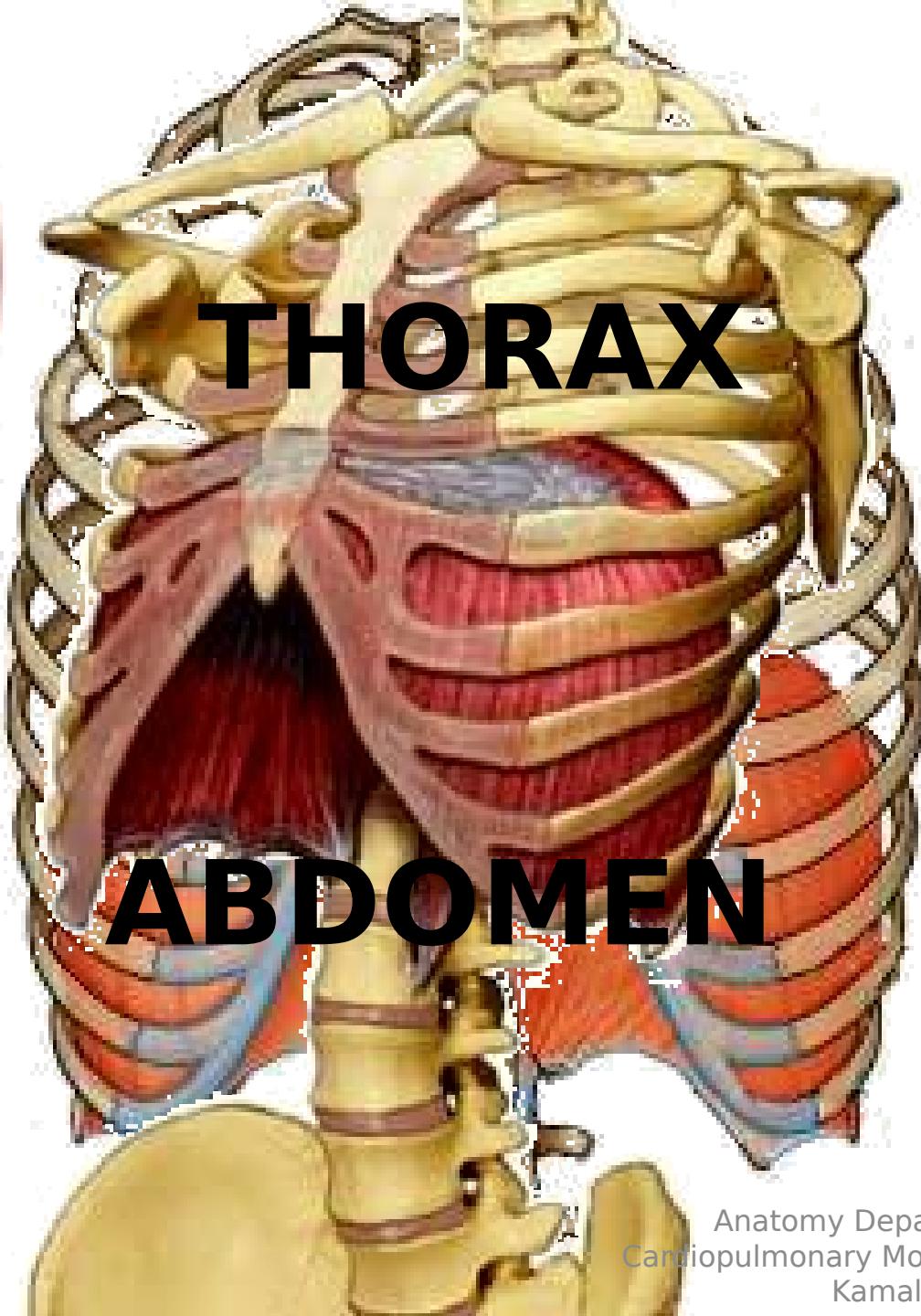


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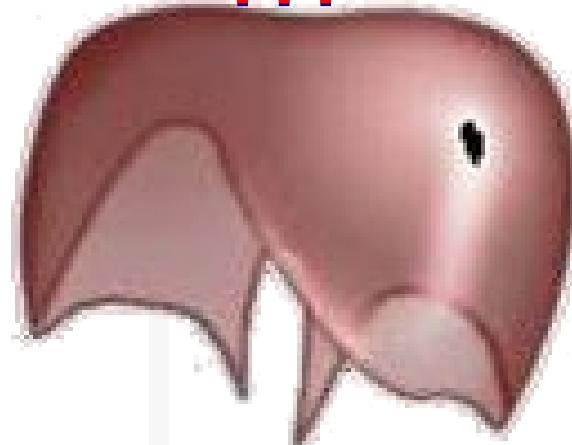
- Outline** the thoracic cage, costal margin, thoracic inlet & outlet.
- Differentiate between true, false and floating ribs.
- Correlate the thoracic cage to its traumatic injury as in fractured ribs
- Identify the joints of the thoracic cage, the type of each joint and the possible movements.
- Demonstrate** the anatomical basis of counting ribs.
- Describe** the arrangement, direction of

KEY POINTS OF THE LECTURE

- 1) Thoracic inlet & thoracic outlet**
- 2) Joints of thoracic cage: types and movements**
- 3) Intercostal muscles: arrangement, direction of fibers, nerve supply & actions**



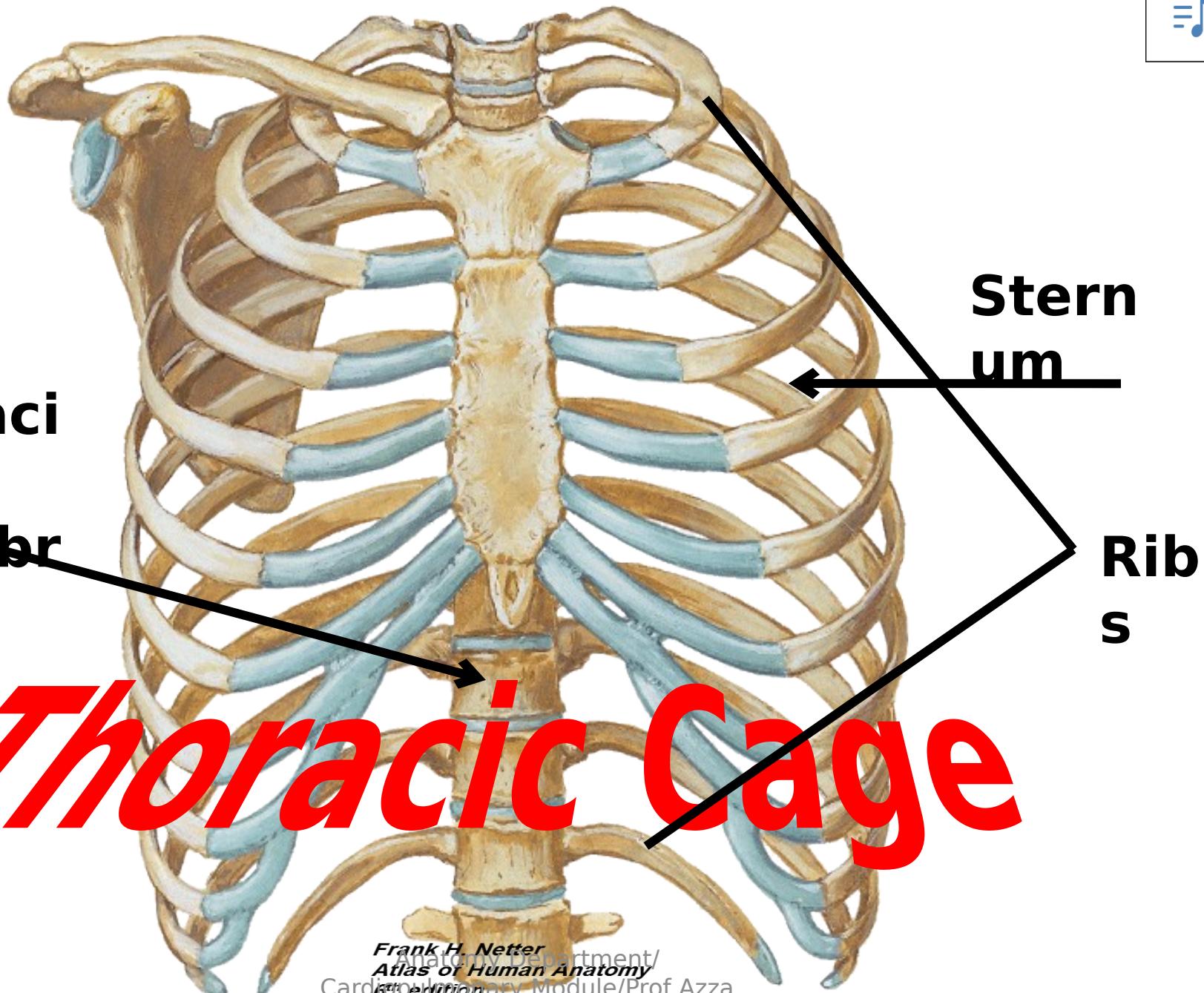
Diaphragm

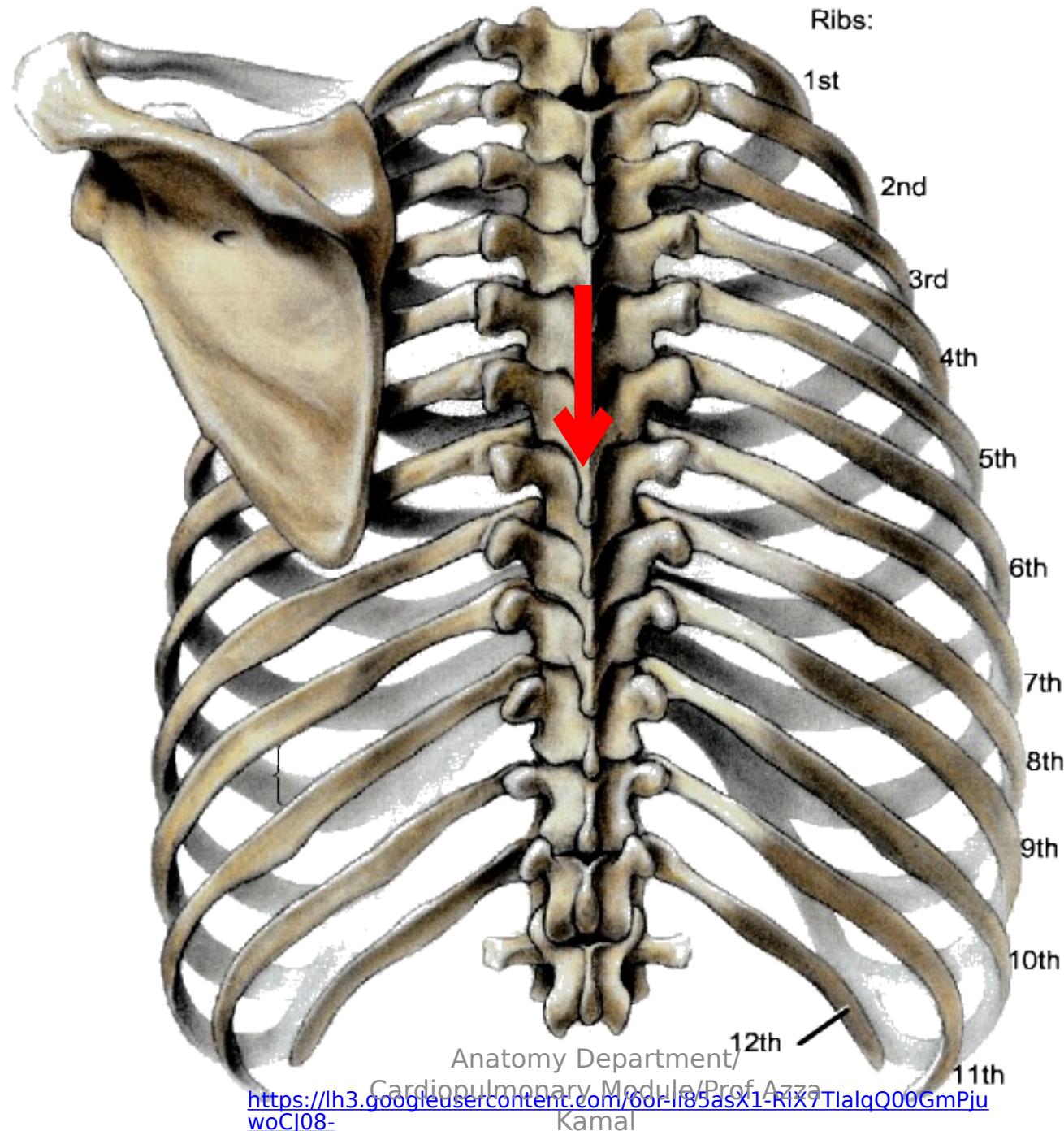




Thoraci
c
vertebr
ae

Thoracic Cage

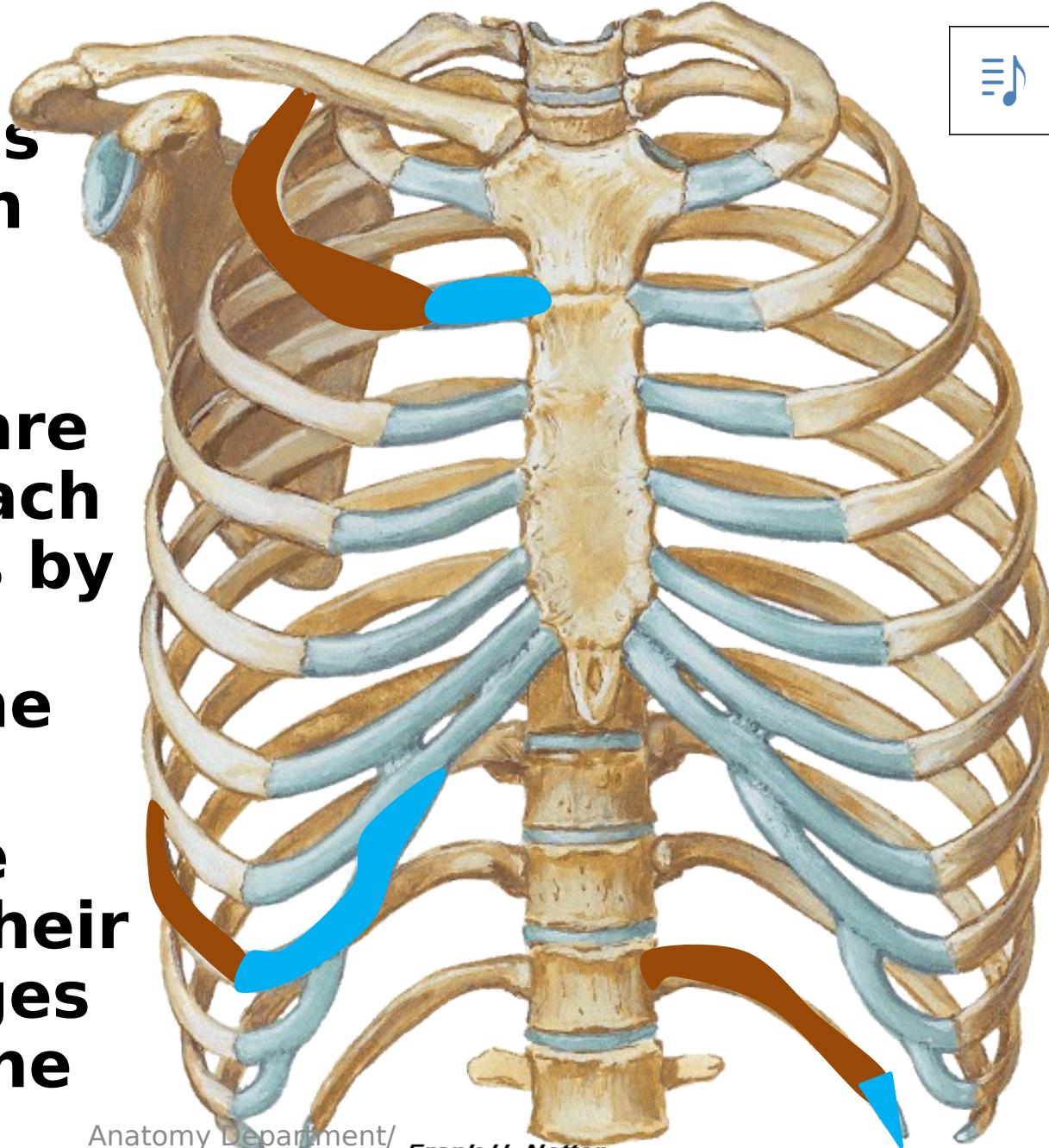




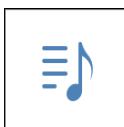
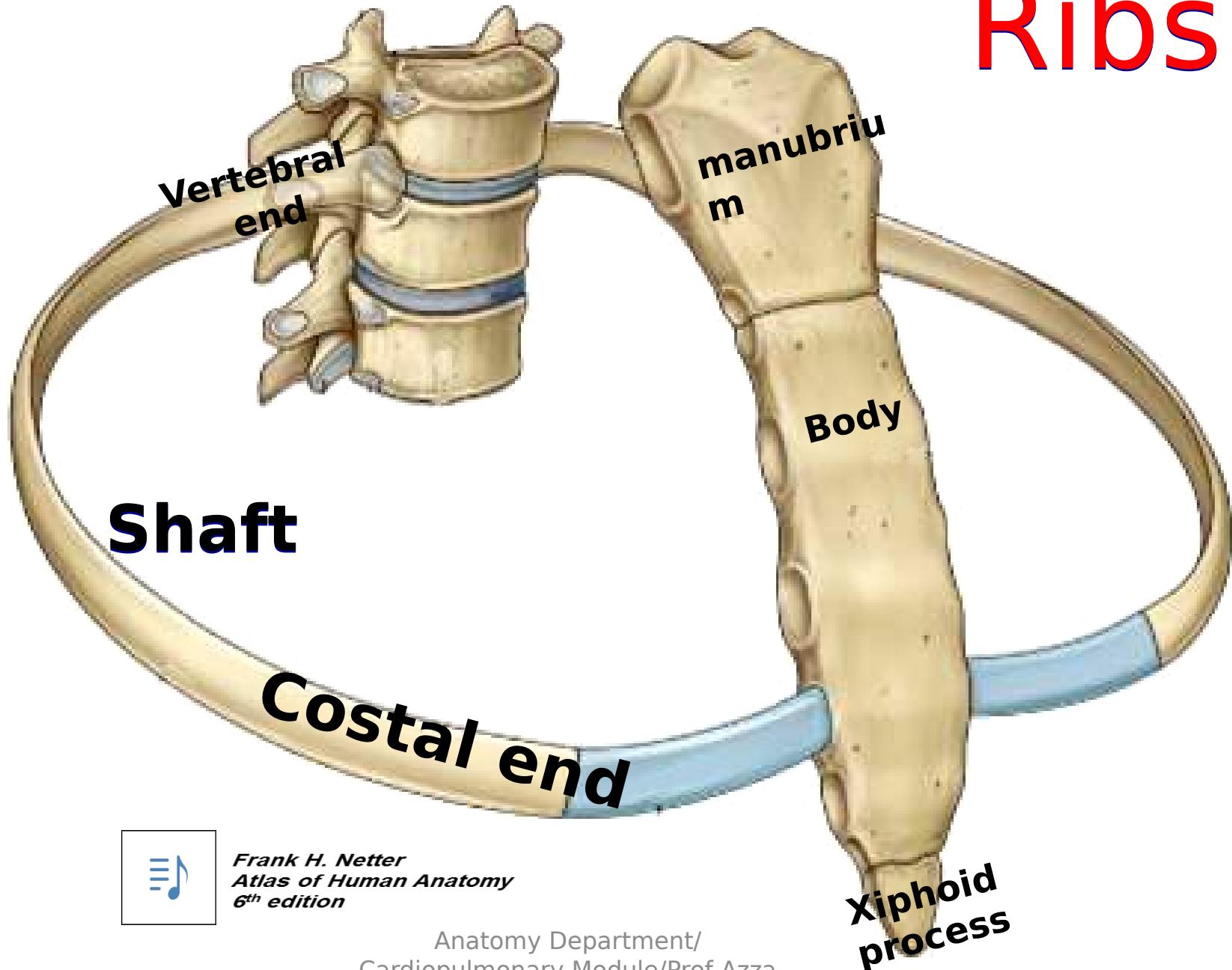


The Ribs

- **12 pairs of ribs articulate with the thoracic vertebrae**
- **Upper seven are true ribs** as each rib articulates by its costal cartilage to the sternum
- **Lower five are false ribs** as their costal cartilages fail to reach the sternum
- **Last two are floating ribs**



Ribs



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vertebral end

Head

Neck

Upper border
of costal groove

upper border of costal groove

V A Intercostal

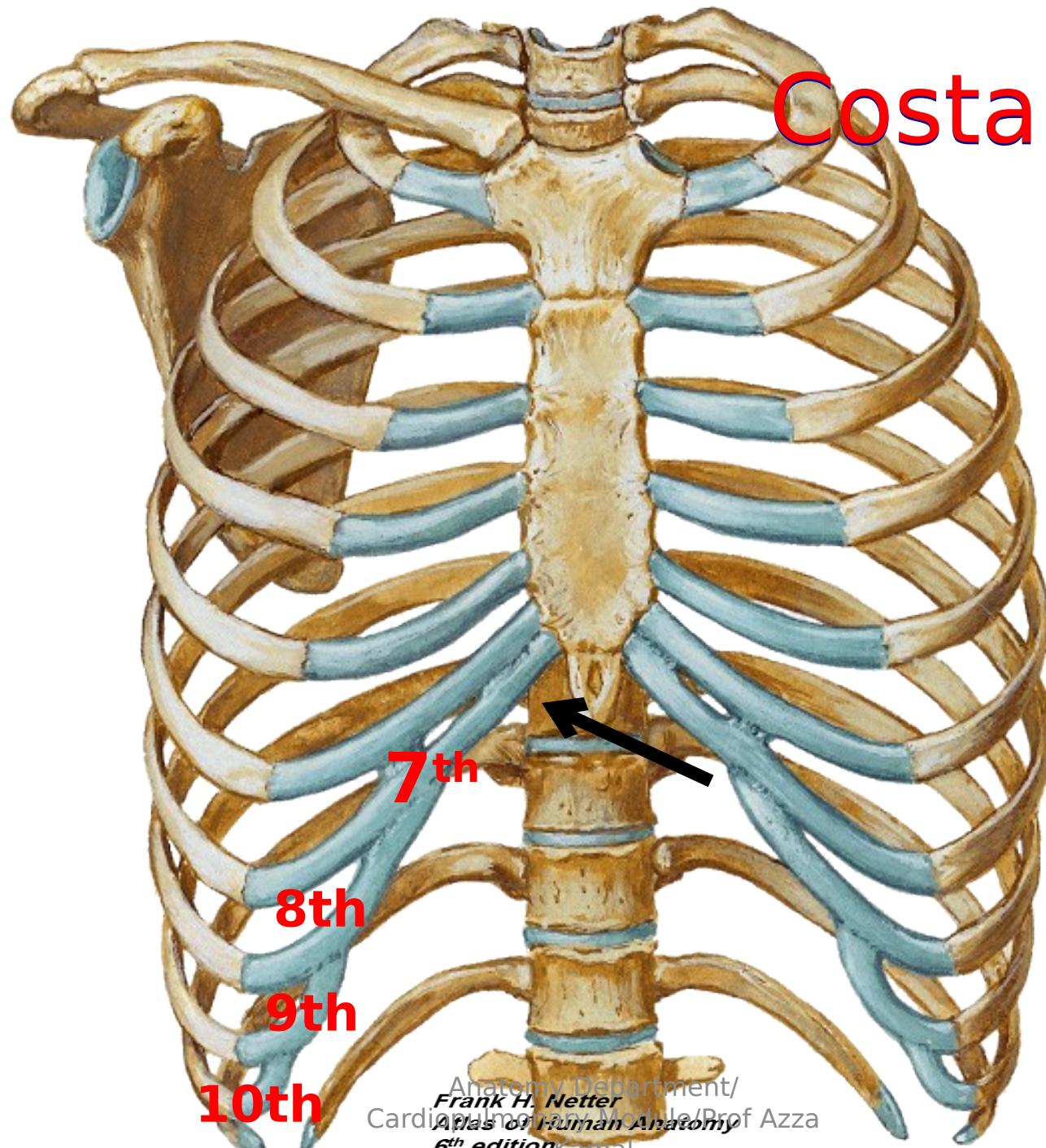
N lower border of costal groove

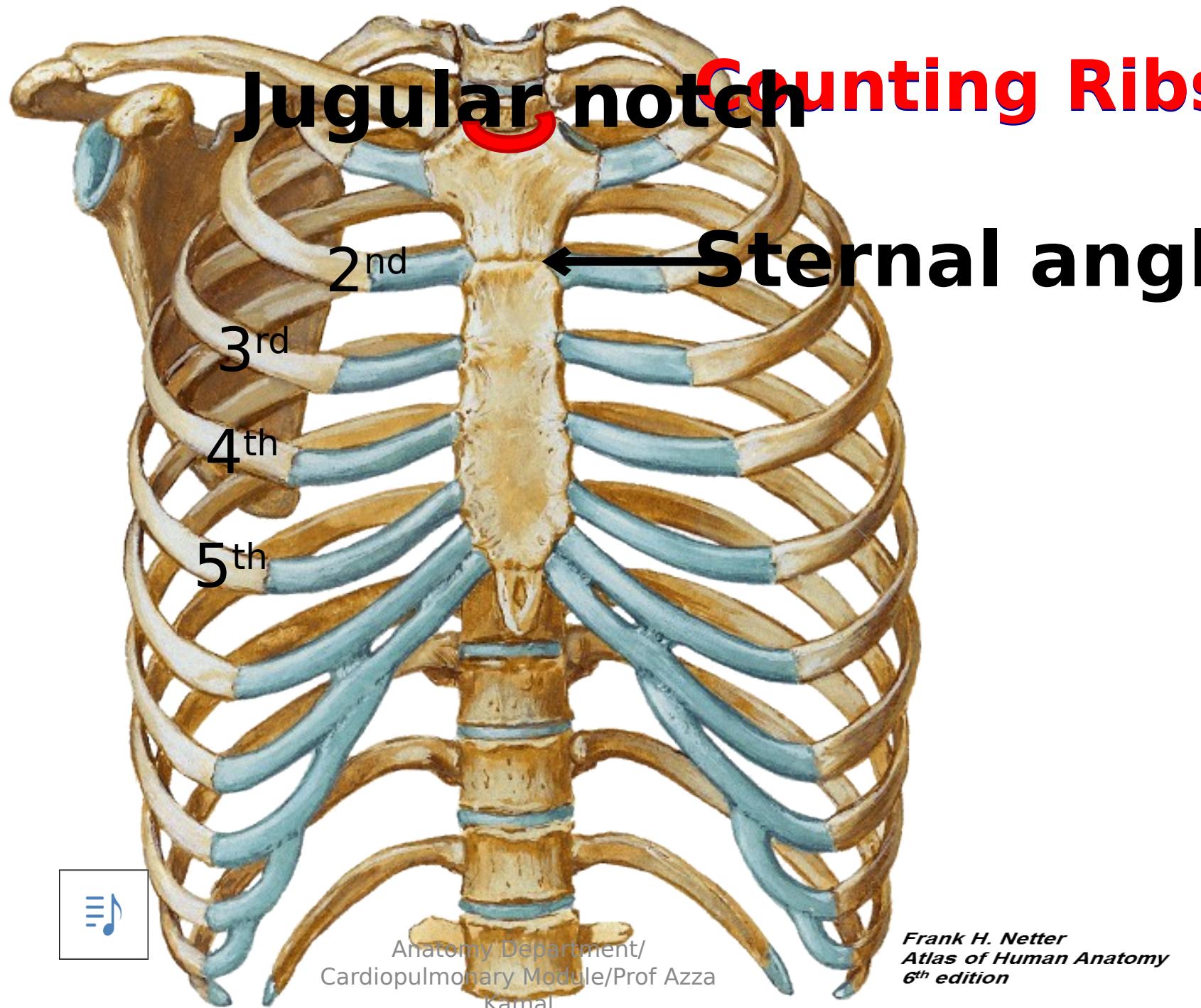
Lower border

Costal end

Costal groove

Costal margin





Thoracic inlet

1st thoracic vertebra

1st rib

Upper border of

Manubrium sterni

Ribs:

2nd

3rd

4th

5th

6th

7th

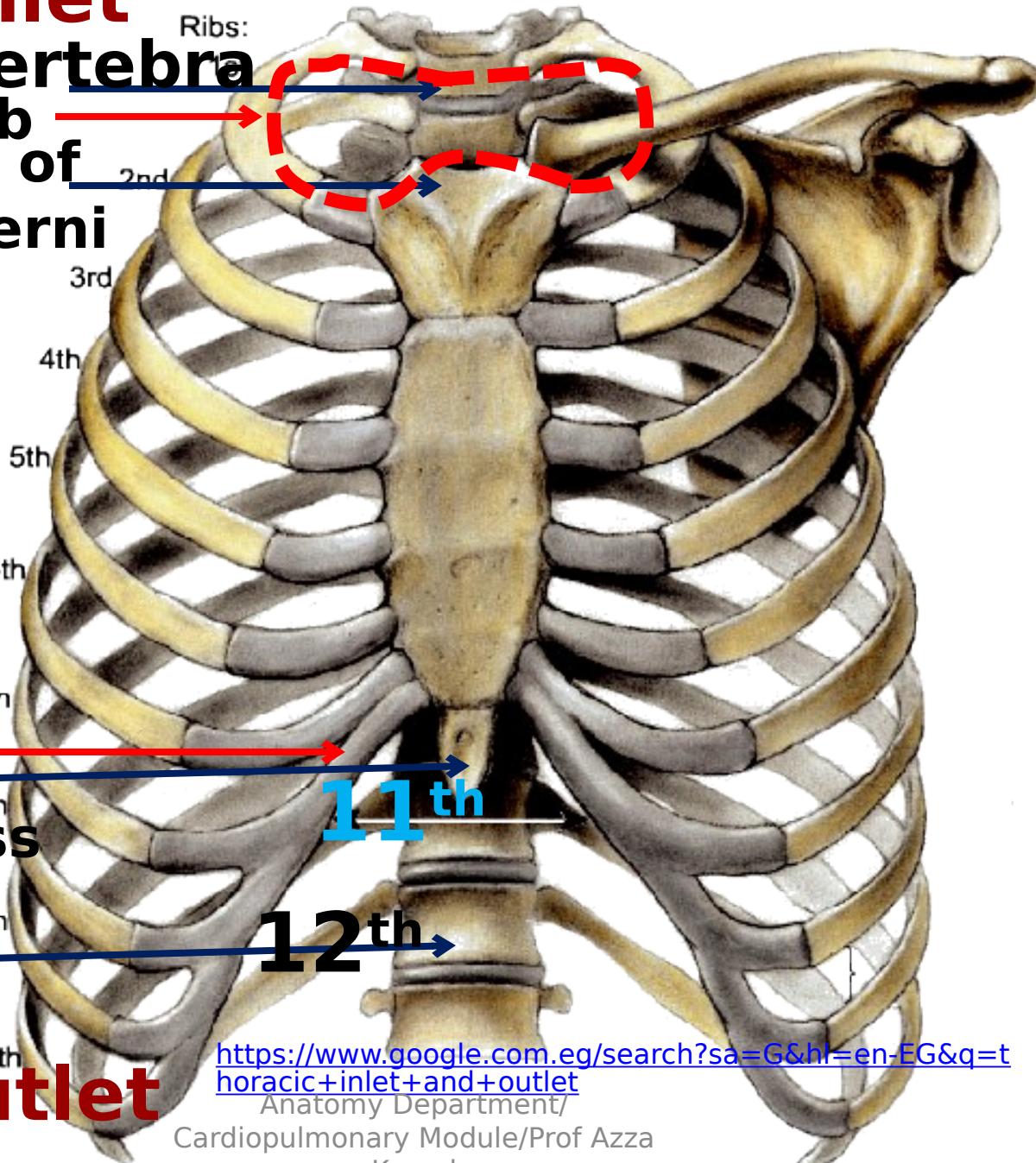
Costal margin

xyphoid process

12th Thoracic

vertebra

horacic outlet



[https://www.google.com.eg/search?sa=G&hl=en-EG&q=t
horacic+inlet+and+outlet](https://www.google.com.eg/search?sa=G&hl=en-EG&q=t horacic+inlet+and+outlet)

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The following are the bones forming the thoracic inlet, Except:

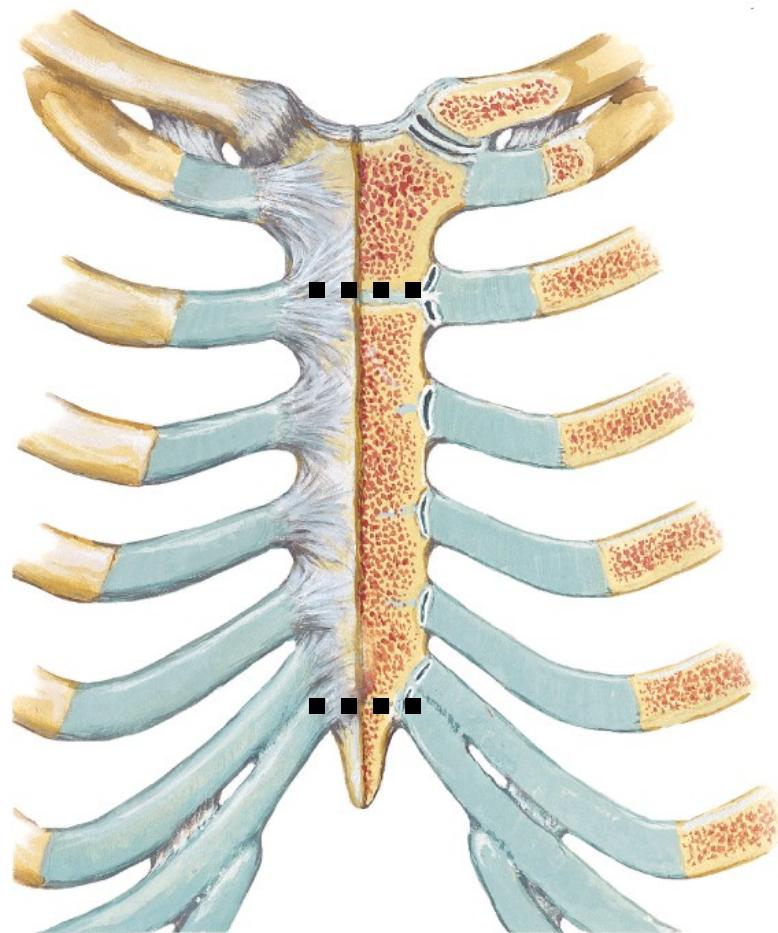
- A) First rib
- B) First thoracic vertebra
- C) Upper border of manubrium sterni
- D) Sternal angle

MCQ tests thoracic inlet & thoracic outlet



Sternal joints

- Mid line joints are 2^{ry} cartilagenous joints
- Manubriosternal & xiphisternal joints are both **2^{ry} cartilaginous** joints
- **May become ossified at old**

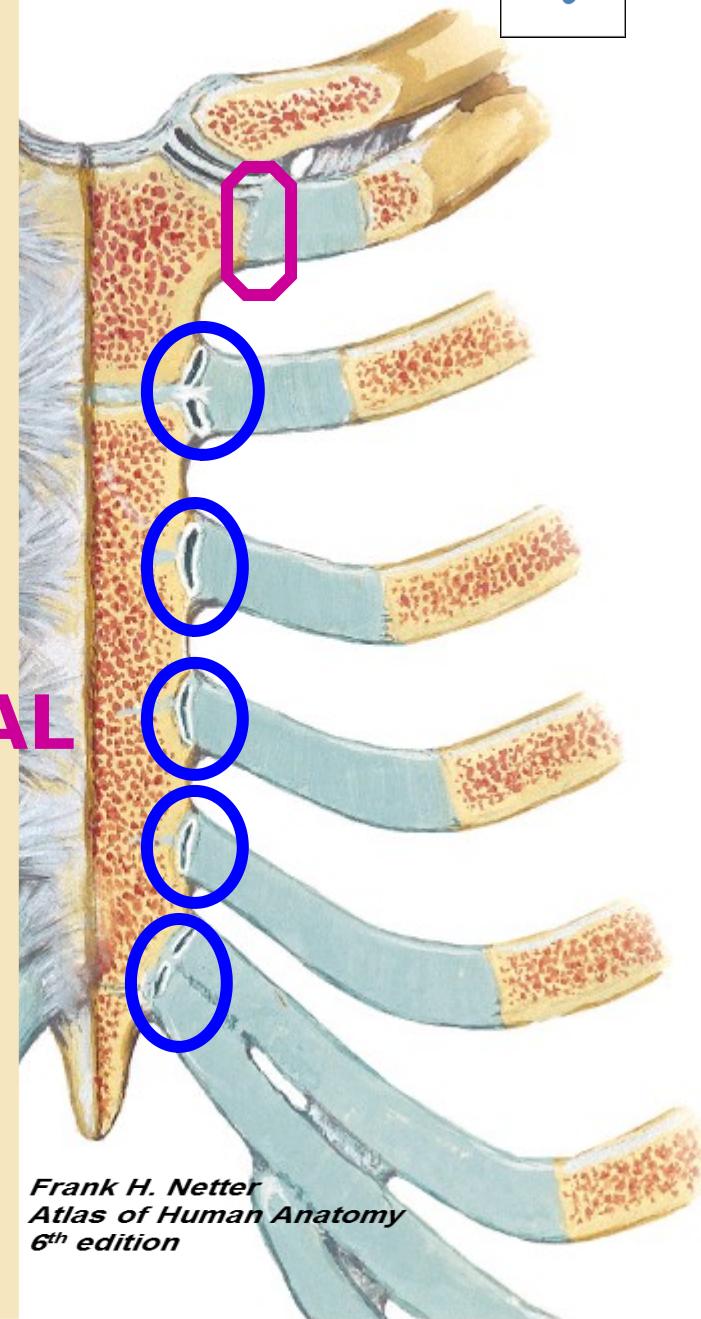




Sternocostal joints:

Plane synovial joints
between costal cartilages of
true ribs & notches on lateral
border of sternum

**EXCEPT FIRST STERNO COSTAL
JOINT ↳ SYNARTHROSES Or
PRIMARY CARTILAGINOUS**
(direct union between 1st costal
cartilage & manubrium sterni)

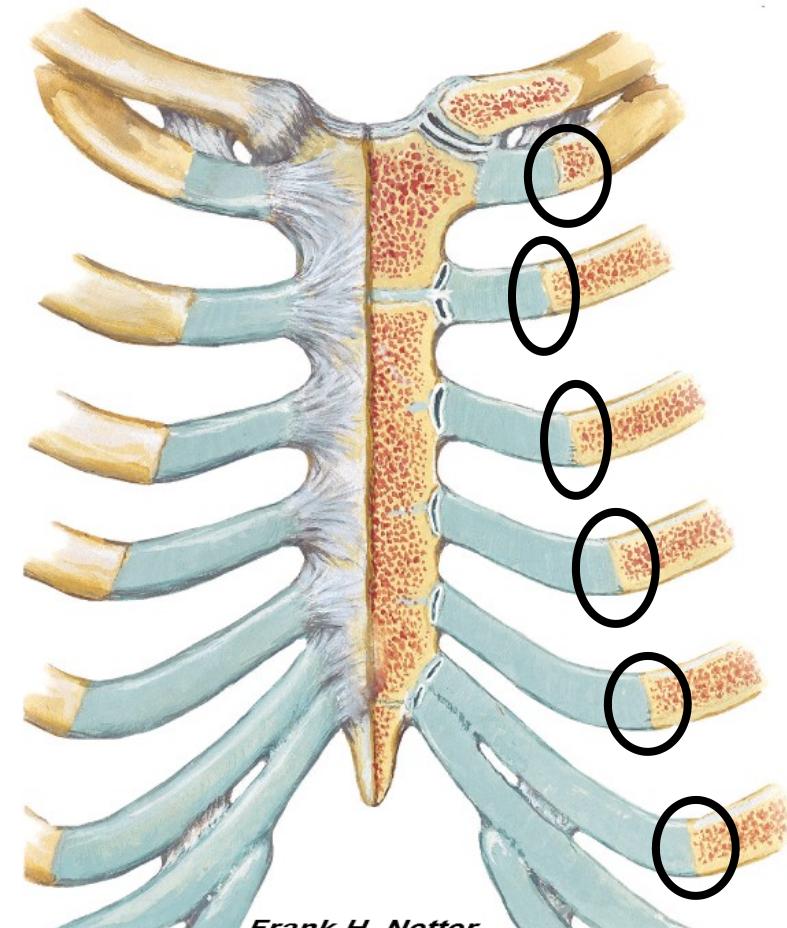


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- **Costochondral joints:**

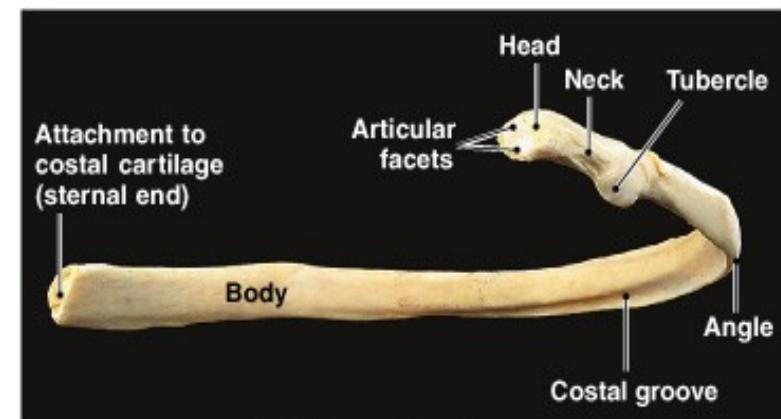
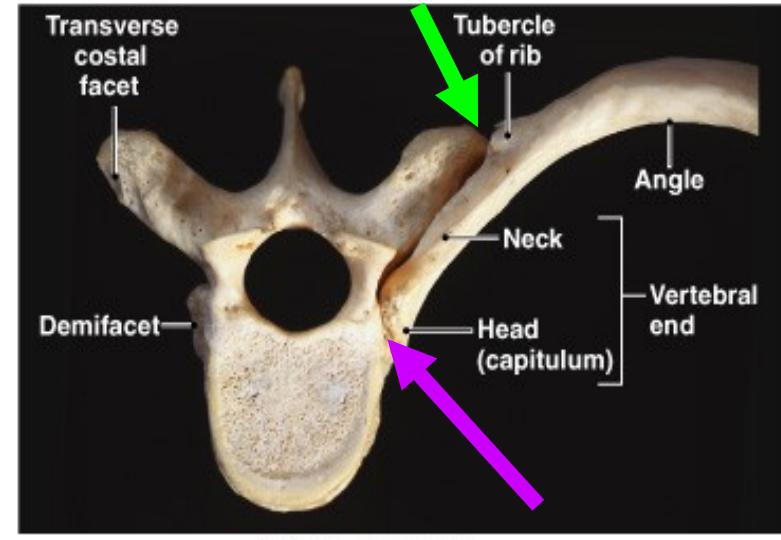
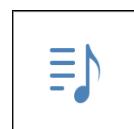
- Between anterior ends of ribs & corresponding costal cartilages ◻
1ry cartilaginous joints
(synarthroses)◻
**NO MOVEMENT
ALLOWED**



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Articulation of vertebra to rib

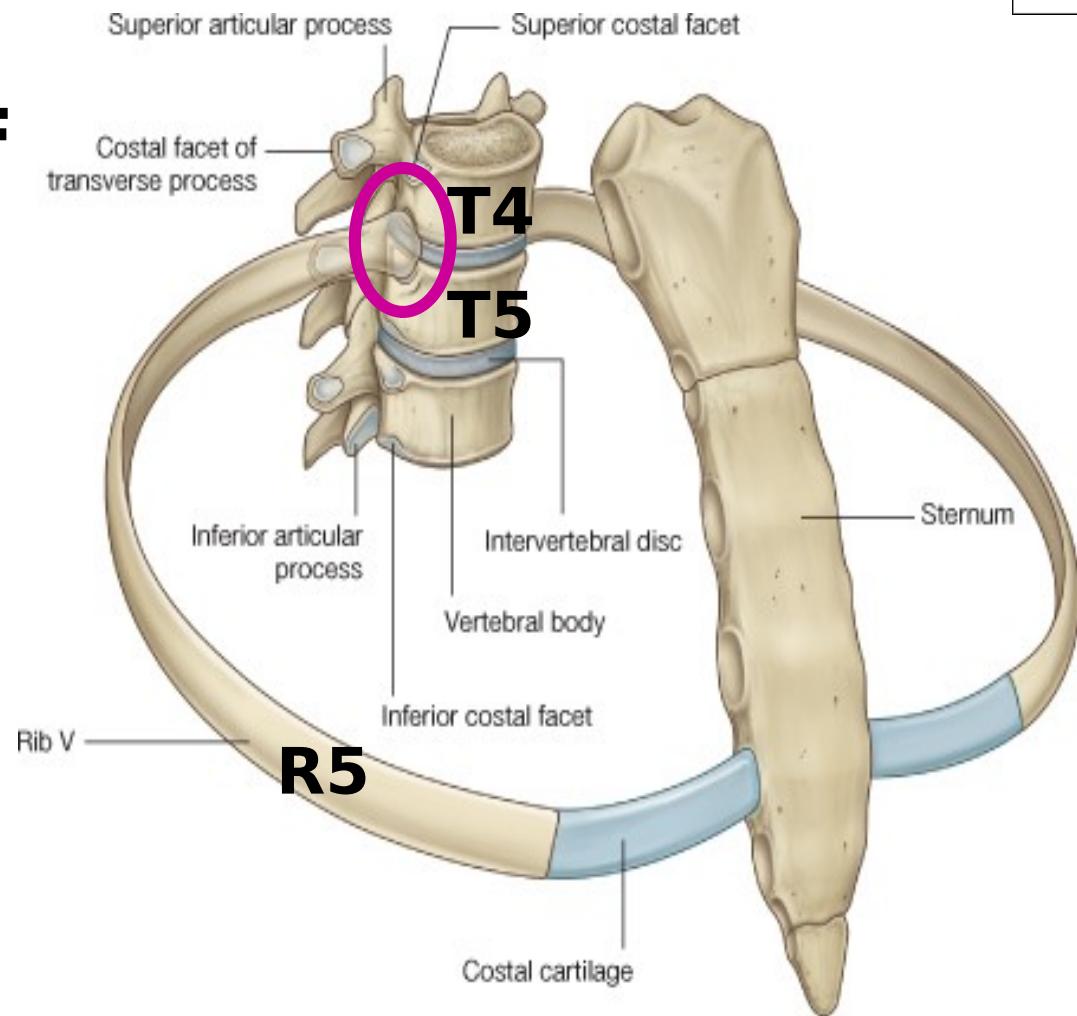
- Head of rib articulates with Body of vertebra
- Tuberclo of rib articulates with Transverse process of vertebra



Costovertebral joints

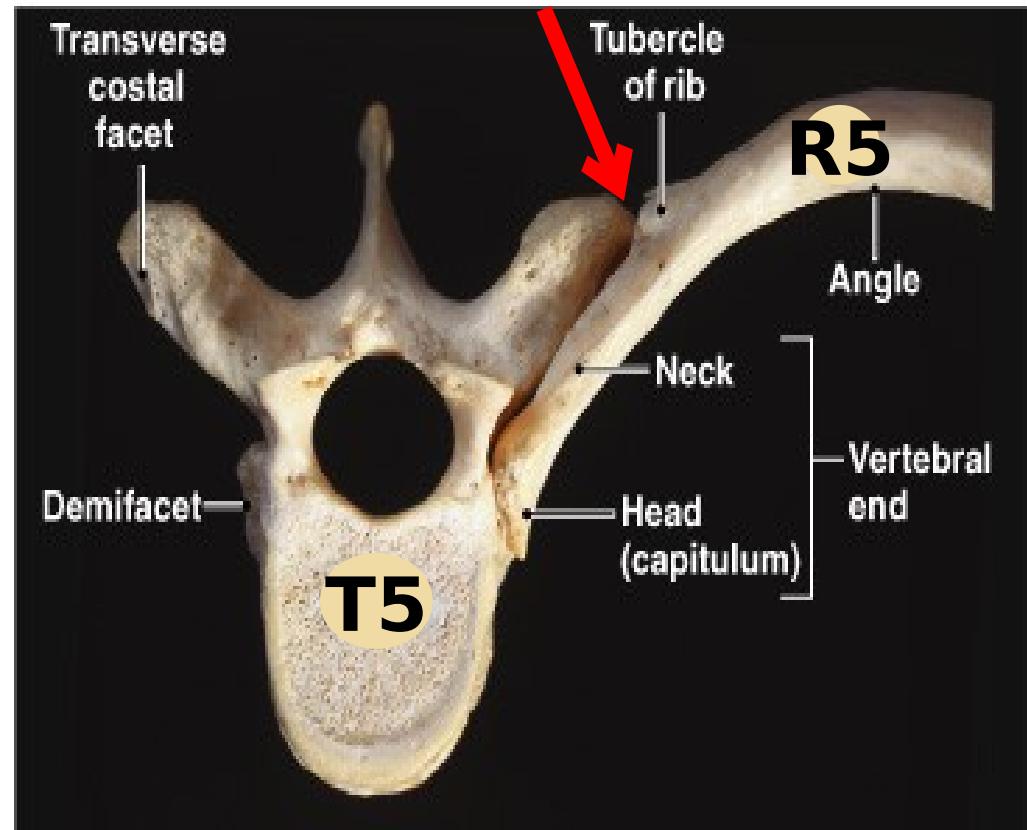


- Demifacets on **heads** of typical ribs articulate with demifacets on **bodies** of thoracic vertebrae □ plane



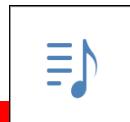
Costotransverse joints

- Between **tubercles of ribs & transverse processes of vertebrae of same number**



(a) Superior view

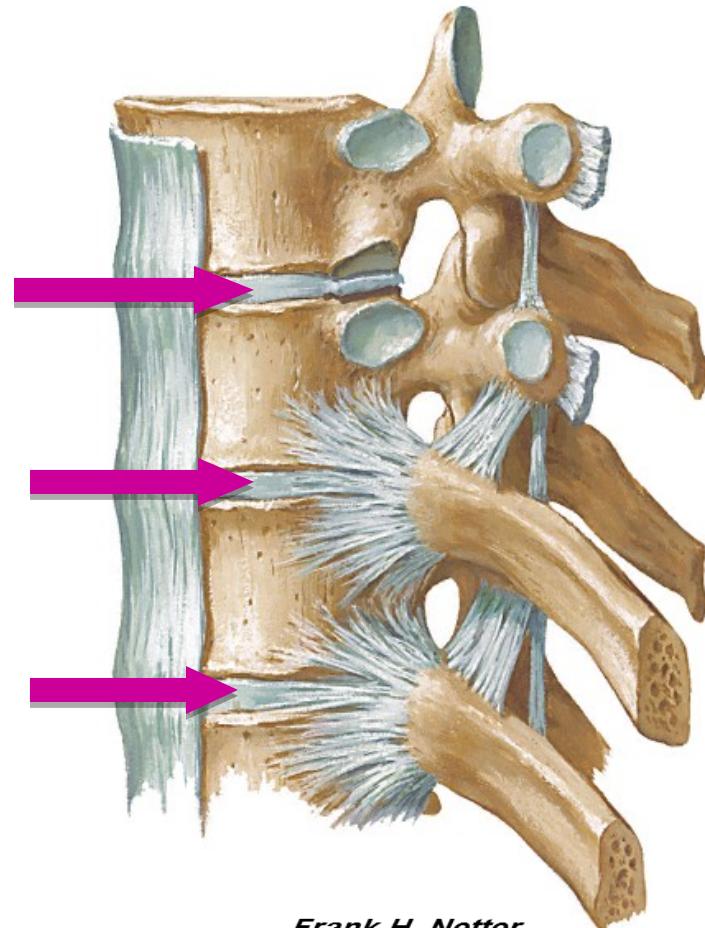
**PLANE
SYNOVIAL
JOINTS**



Joints of vertebral bodies



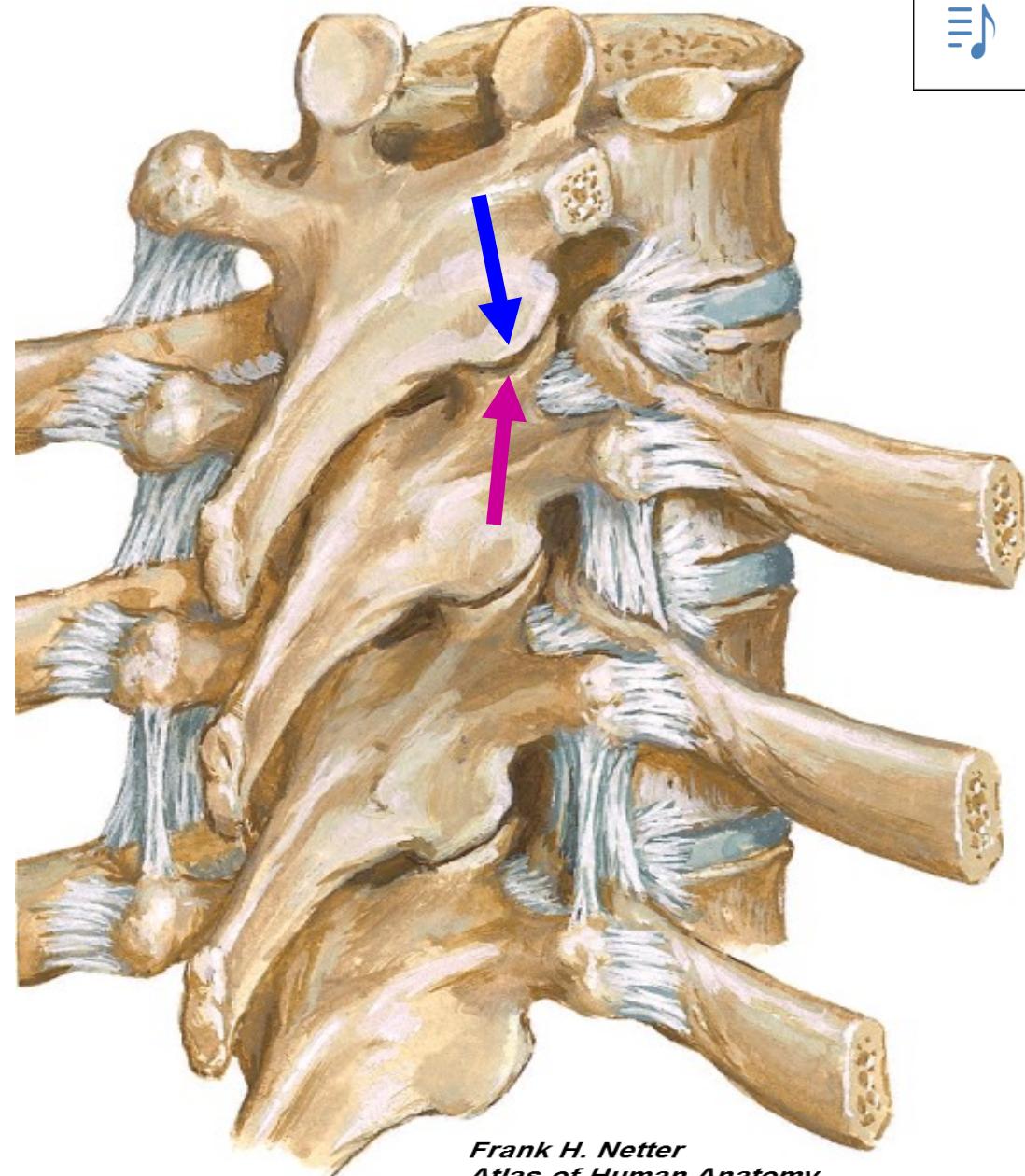
- **Bodies of thoracic vertebrae are connected by intervertebral discs** ↗ 2ry cartilaginous joints
- **Midline Joints**



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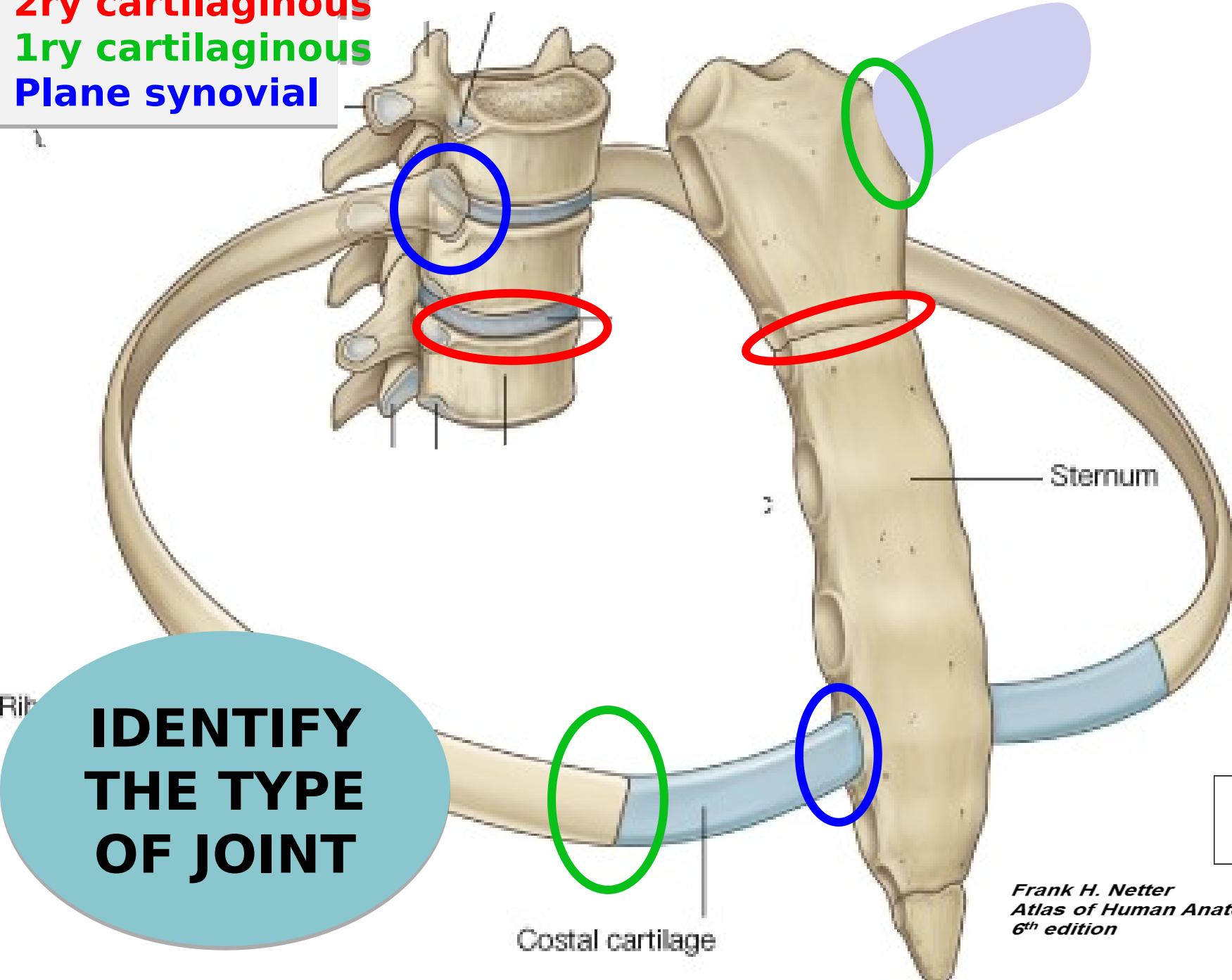


- Inferior articular facets of vertebra above articulate with superior articular facets of vertebra below



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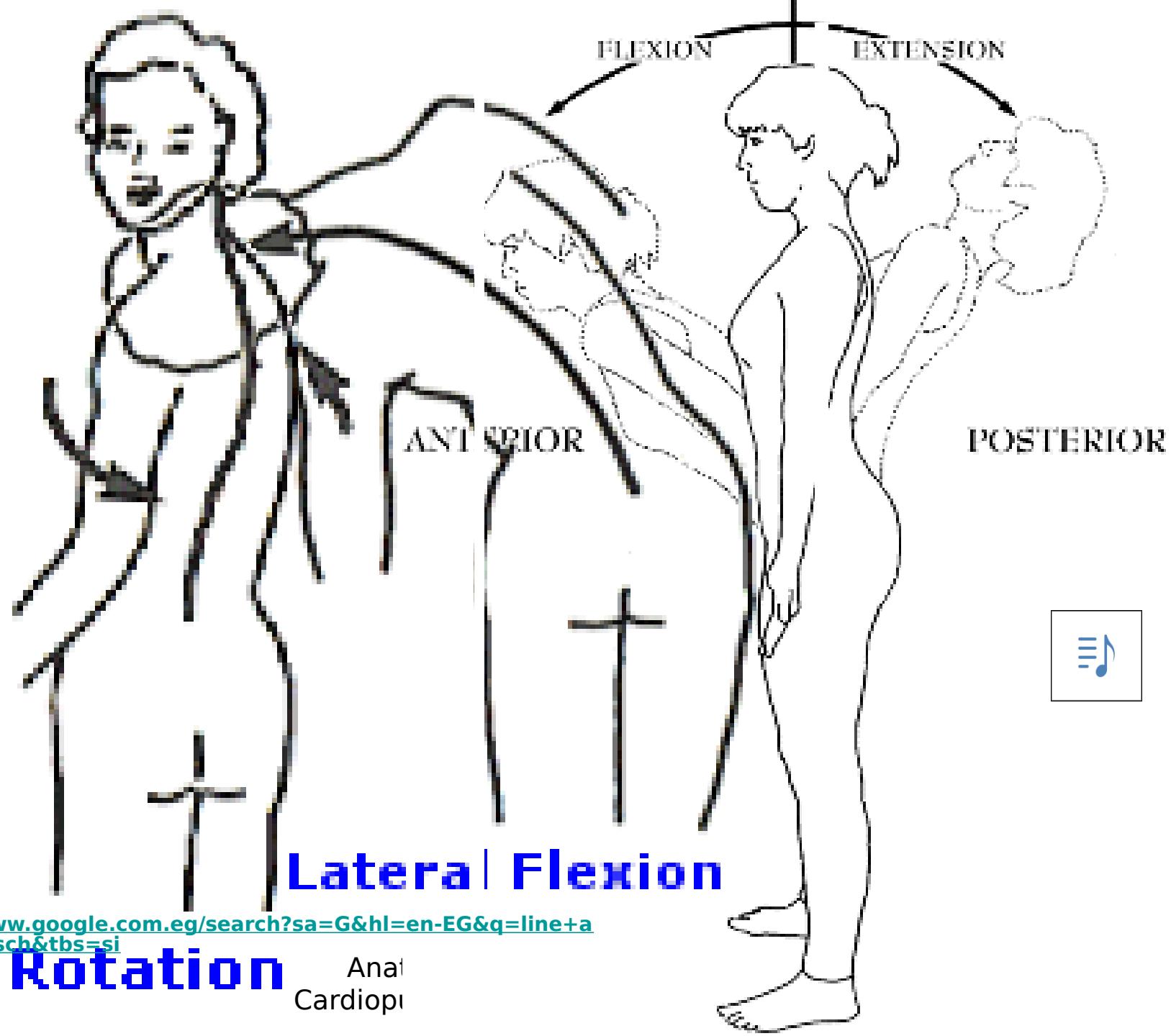
2ry cartilaginous
1ry cartilaginous
Plane synovial



Movements of joints of the thorax

- Thoracic vertebrae can do:
 1. Flexion
 2. Extension
 3. Lateral flexion
 4. Rotation
- Joints between vertebrae & ribs can do slight gliding movements only
- Sternocostal joints allow limited degree of gliding movement
- Joints between ribs & costal cartilages allow no movement





Lateral Flexion

<https://www.google.com.eg/search?sa=G&hl=en-EG&q=line+ar+rt&tbs=isch>

Rotation

Anat
Cardiopi



Which of the following joints of the thoracic cage allows NO MOVEMENT?

- A) Sternocostal
- B) Costovertebral
- C) Costotransverse
- D) Between rib and costal cartilage**
- E) Intervertebral

MCQ tests movements of joints of thoracic cage



Important Clinical Notes

- Traumatic injury to the thorax is common especially in car accidents.
- In children the ribs are elastic □ rarely fractured
- In adults □ ribs tend to break in their weakest point (angle of rib)
- 1st & 2nd ribs are protected by the clavicle & pectoralis major .
- Last 2 ribs are floating □ rarely



□ In severe crush injuries, a number of ribs maybe fractured .

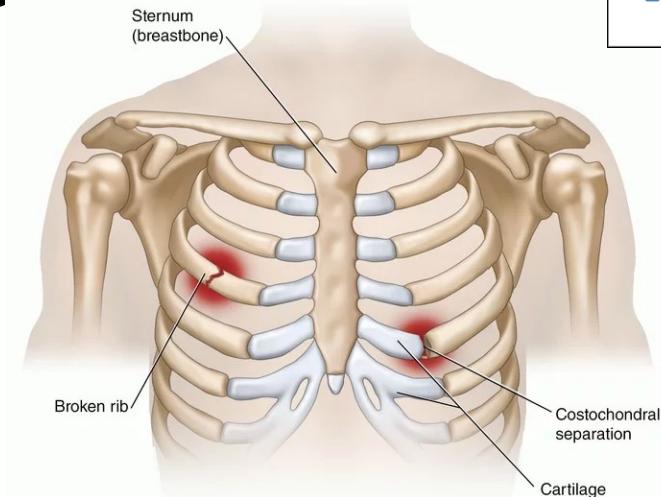
□ The fracture may be at the angle of rib or near the costochondral junction

□ **flail chest**

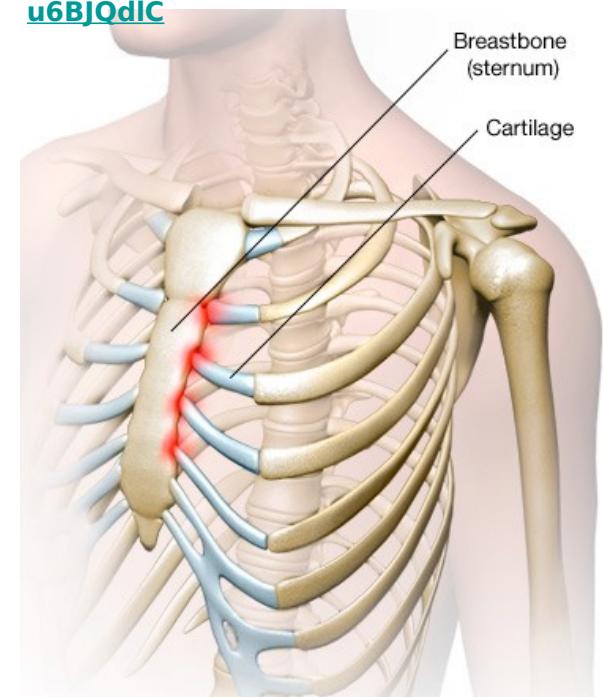
□ Fracture on either side of the sternum

□ **flail sternum**

In both cases the stability of chest wall is lost and the flail segment is sucked in with inspiration and out with expiration



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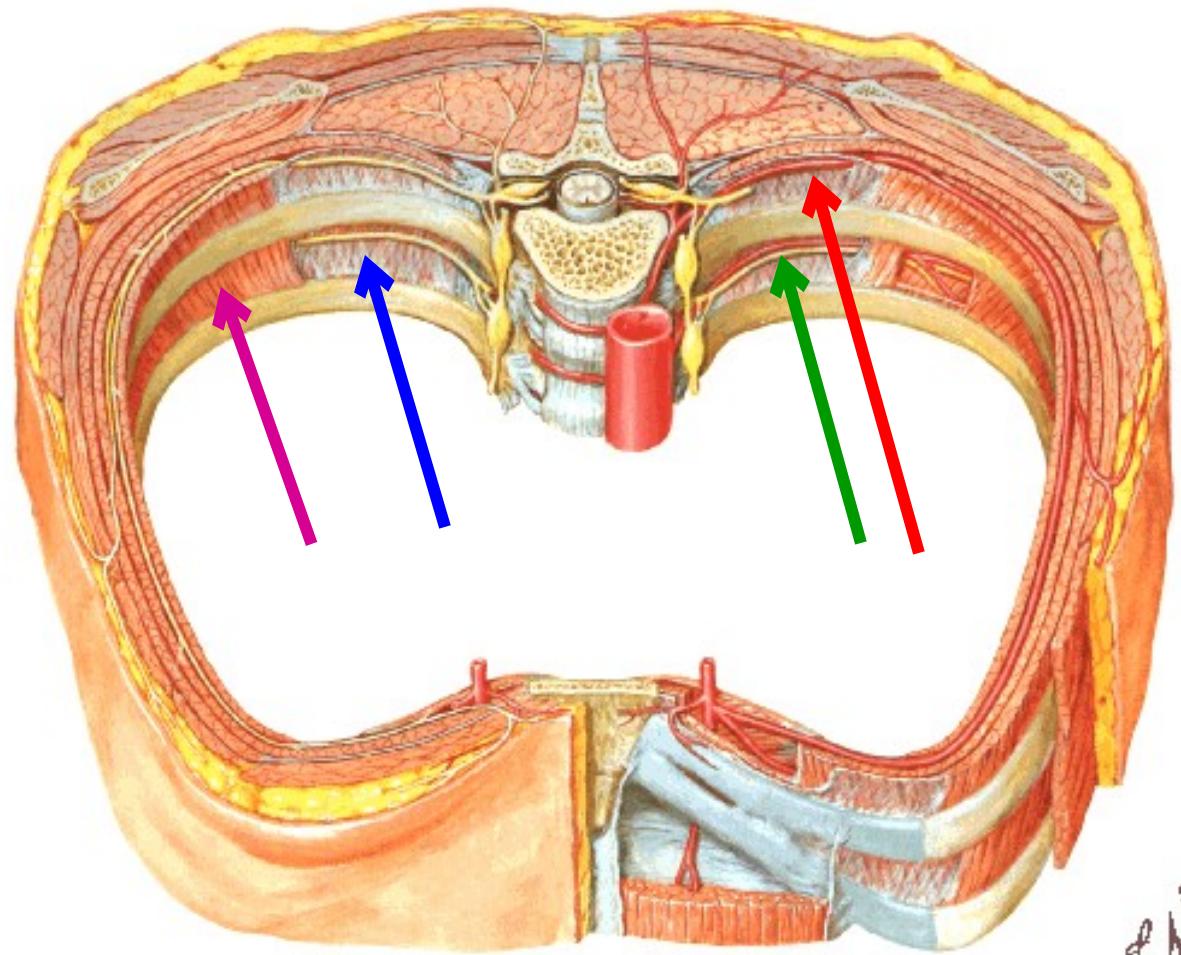


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Thoracic Wall



- Formed by the thoracic cage + the soft tissues which occupy the intercostal spaces
- Intercostal muscles, membranes, nerves & vessels

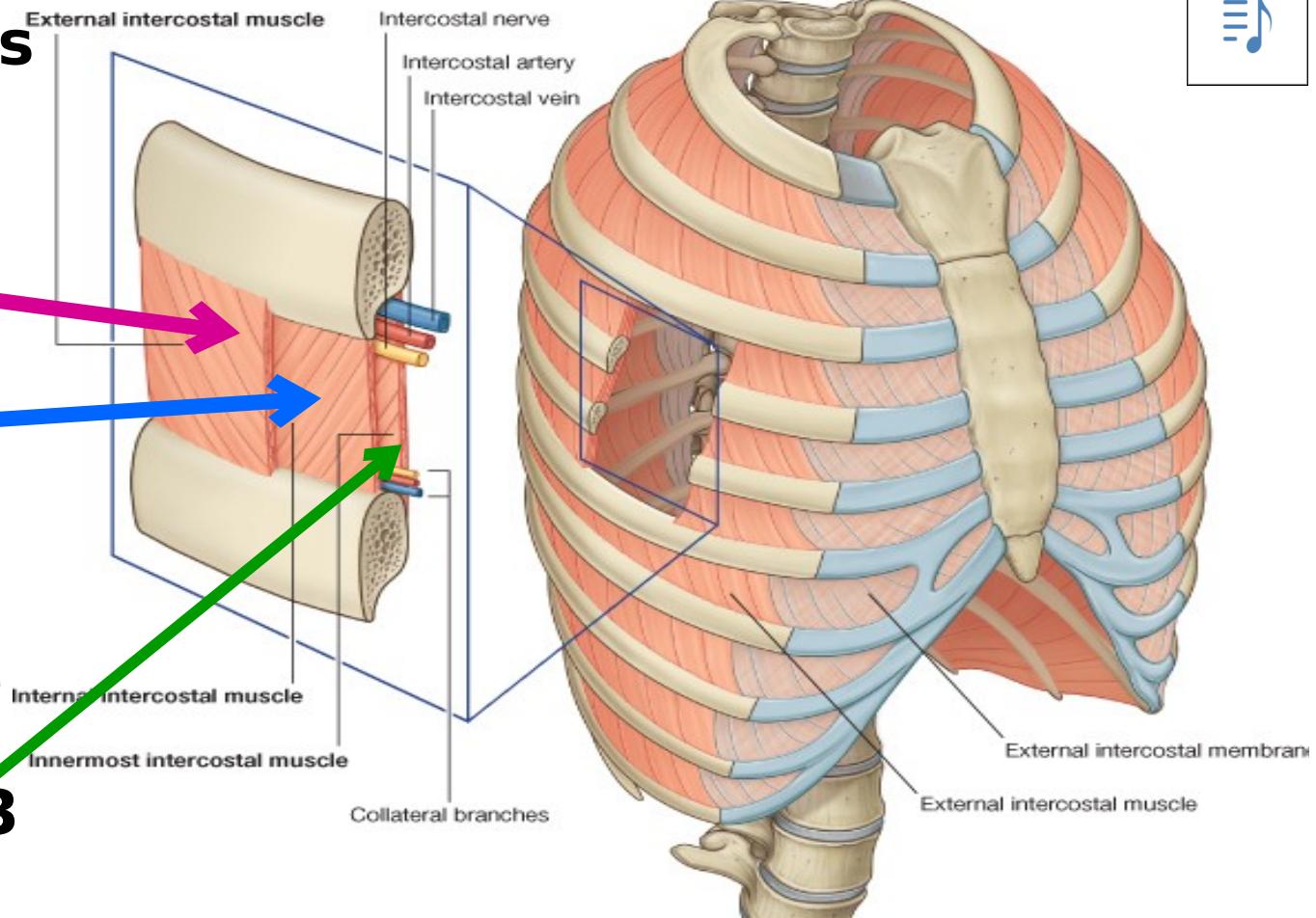


Intercostal muscles and membranes



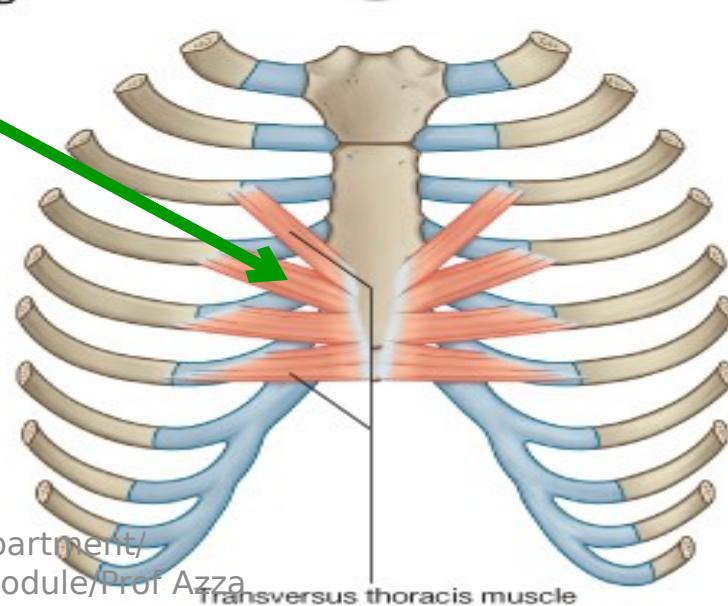
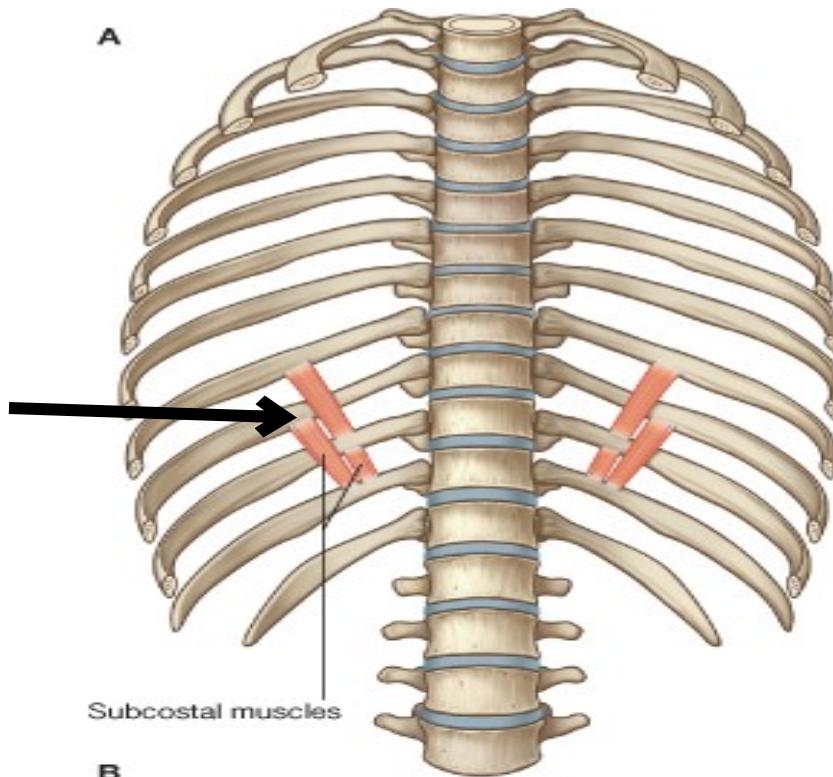
- **3 layers of flat muscles from outside inwards are :**

1. **External intercostal**
2. **Internal intercostal**
3. **Incomplete layer formed of 3 muscles innermost intercostal, subcostal, transversus**



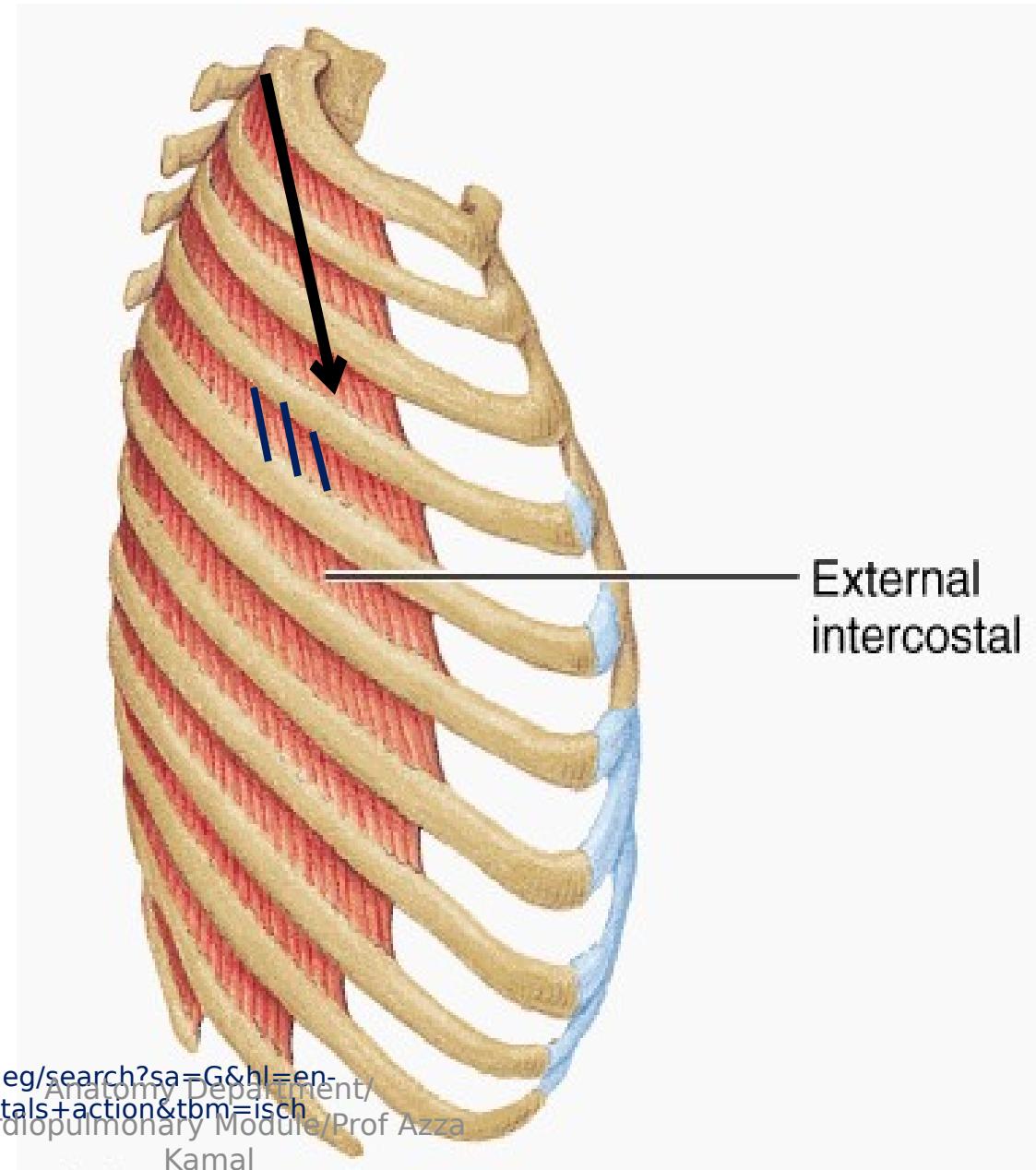
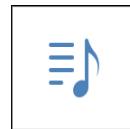


- **Subcostal
and
transversu
s thoracis
muscles**



External intercostal

- Fibers □
oblique
y
downwa
rds &
forwards



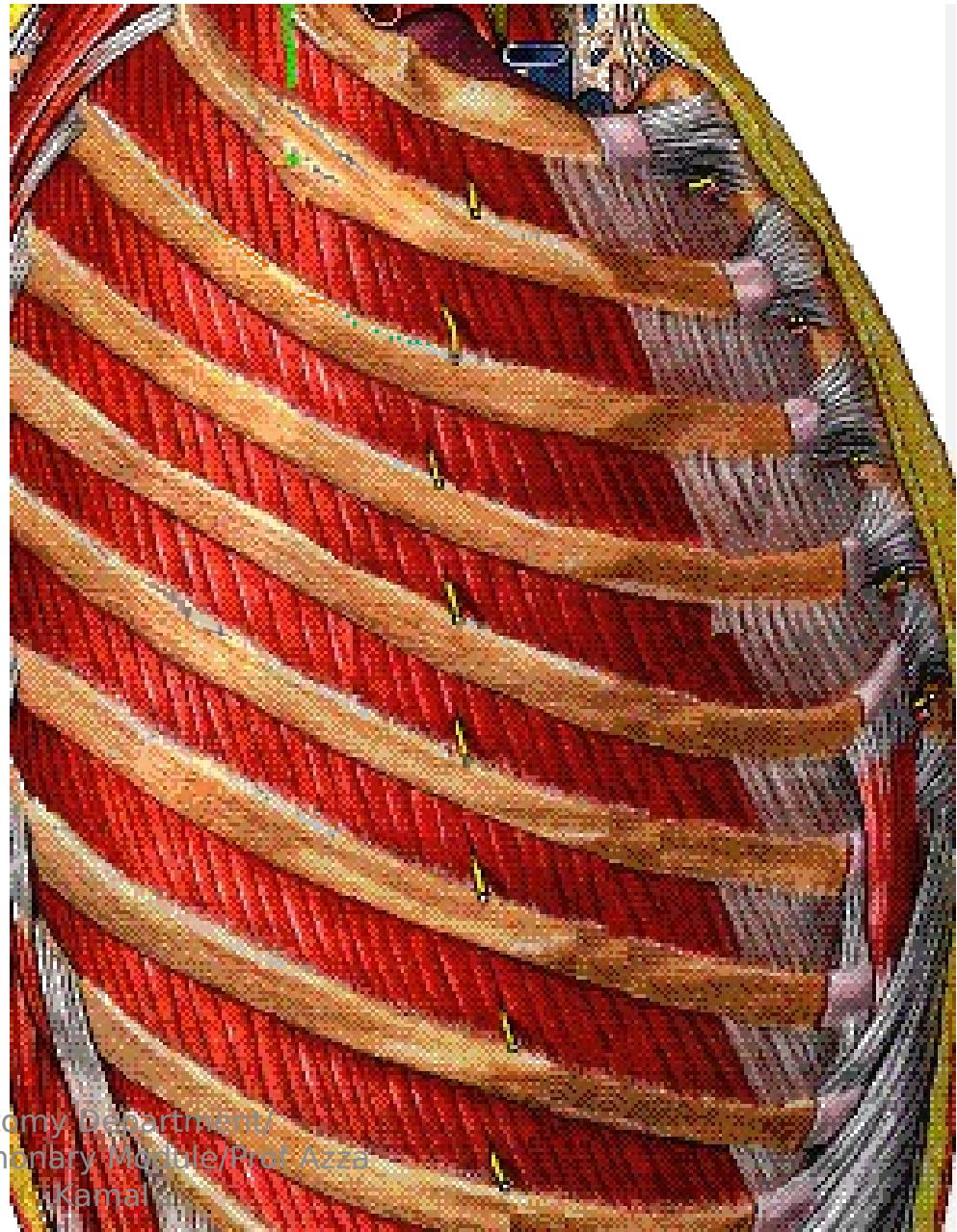
<https://www.google.com.eg/search?sa=G&hl=en-EG&q=internal+intercostals+action&tbo=isch>

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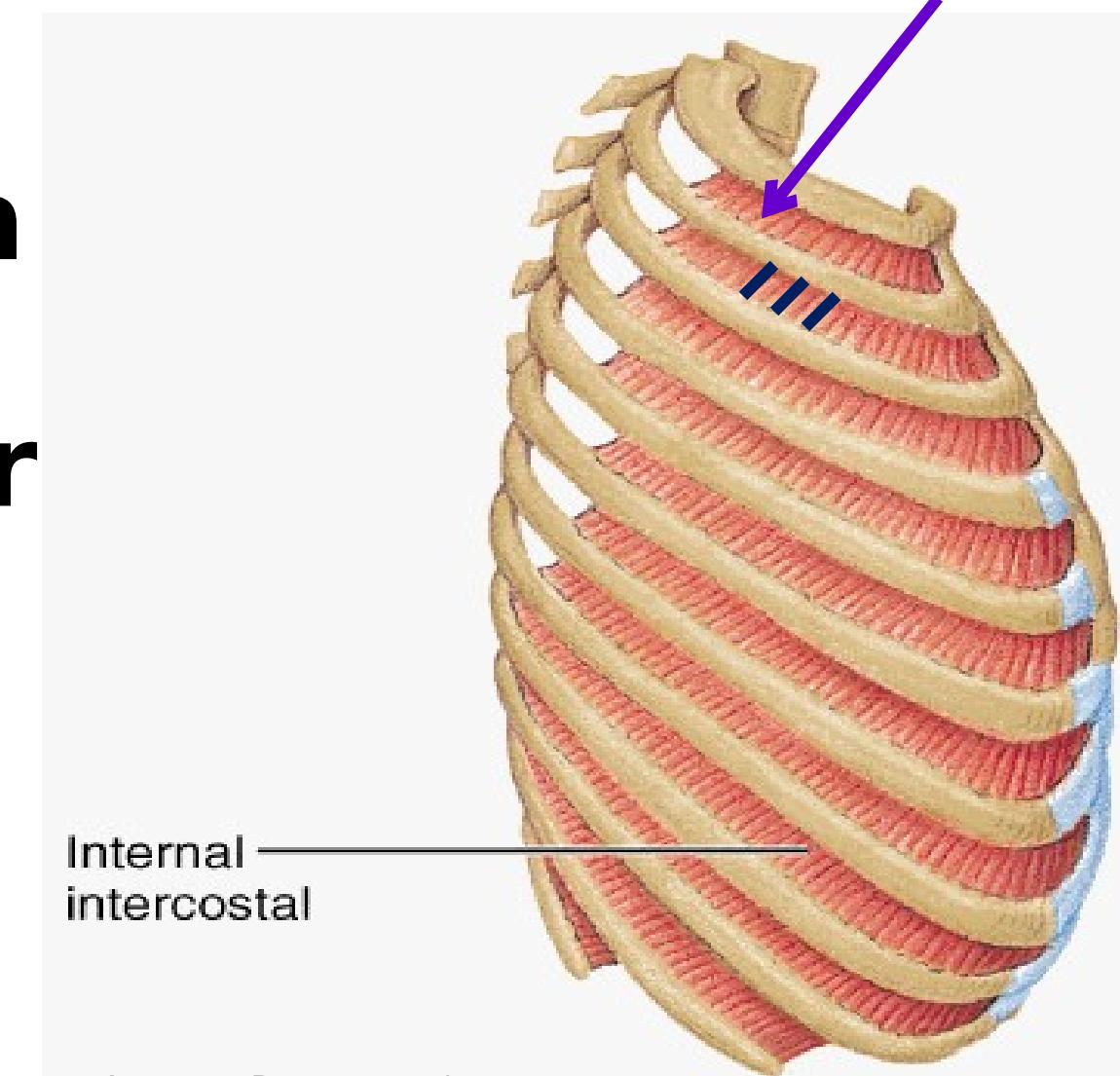
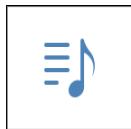
External intercostal (cont)

- **Extent** from the tubercle of the rib posteriorly to the junction of rib with its costal cartilage anteriorly where it is replaced by anterior intercostal membrane which extends to lateral margin of



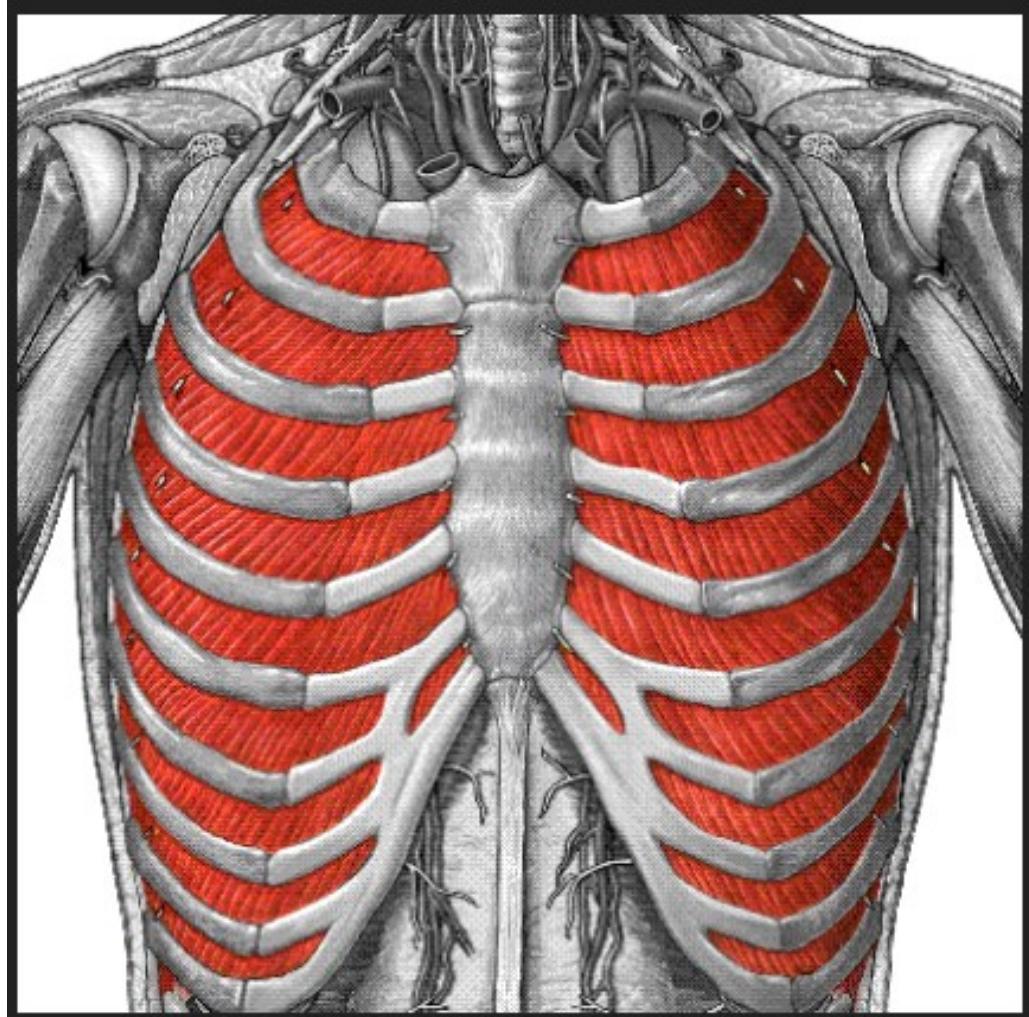
Internal intercostal muscle

- Fibers □
downwa
rds &
backwar
ds



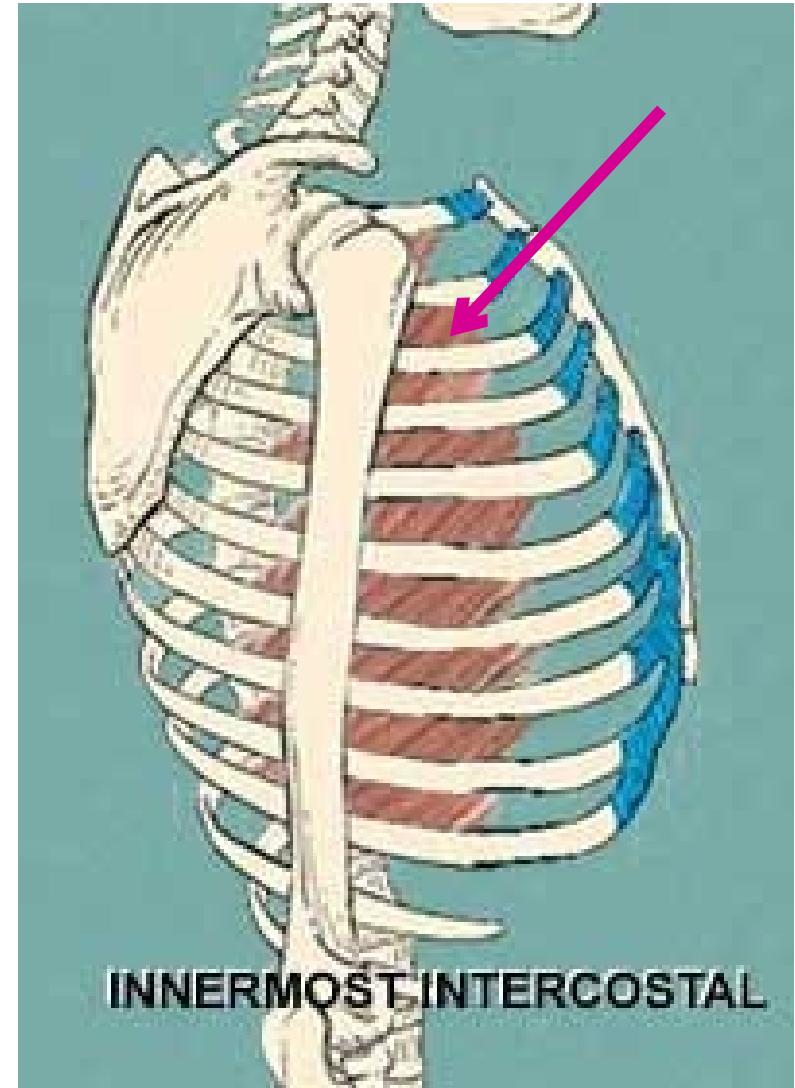
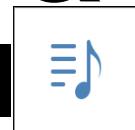
Internal intercostal (cont)

- Begins from lateral margin of sternum anteriorly to angle of rib posteriorly where it is replaced by the **posterior intercostal membrane**



Innermost intercostal

- It is a part of internal intercostal which is split off by the intercostal nerve & vessel

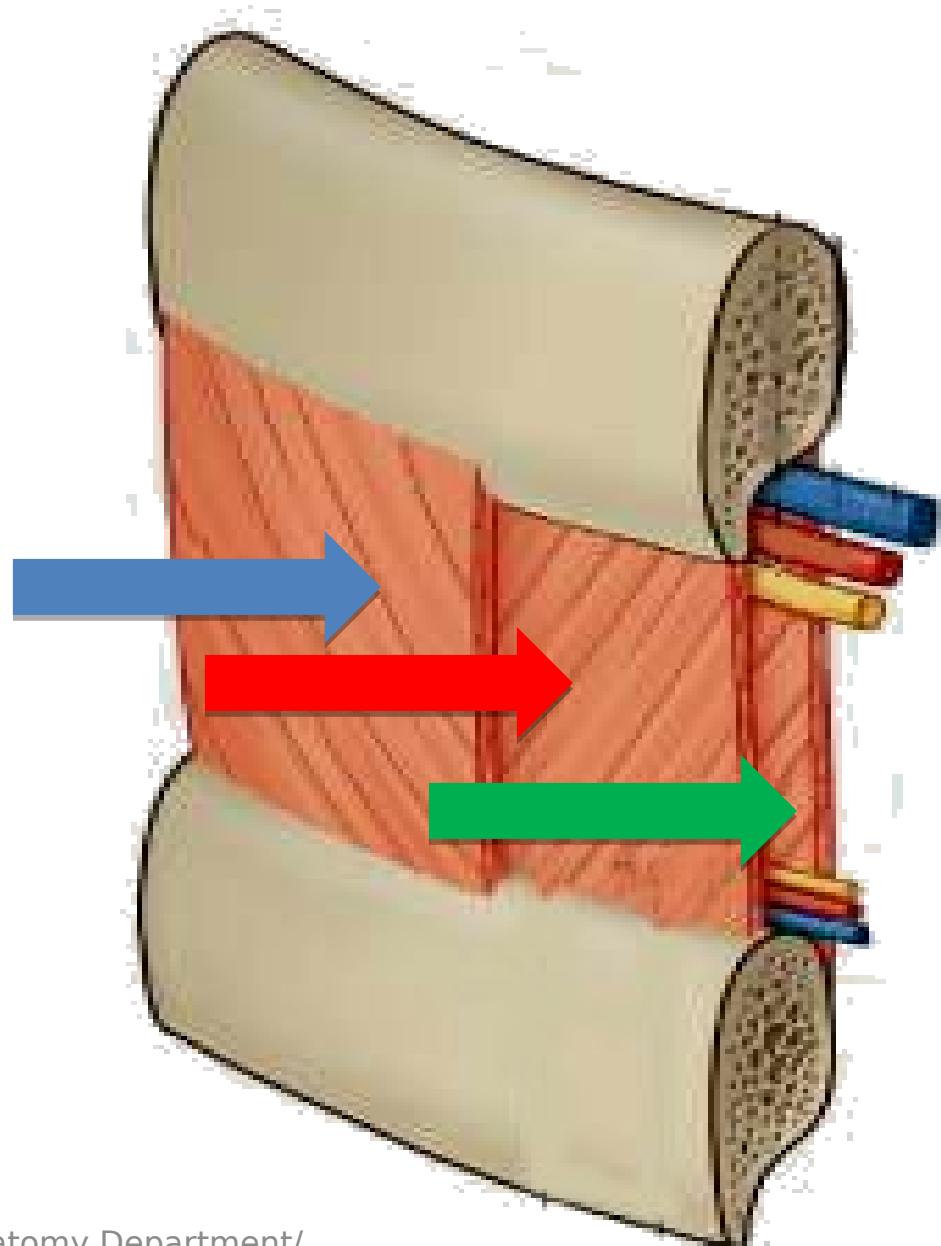




External intercos- tal

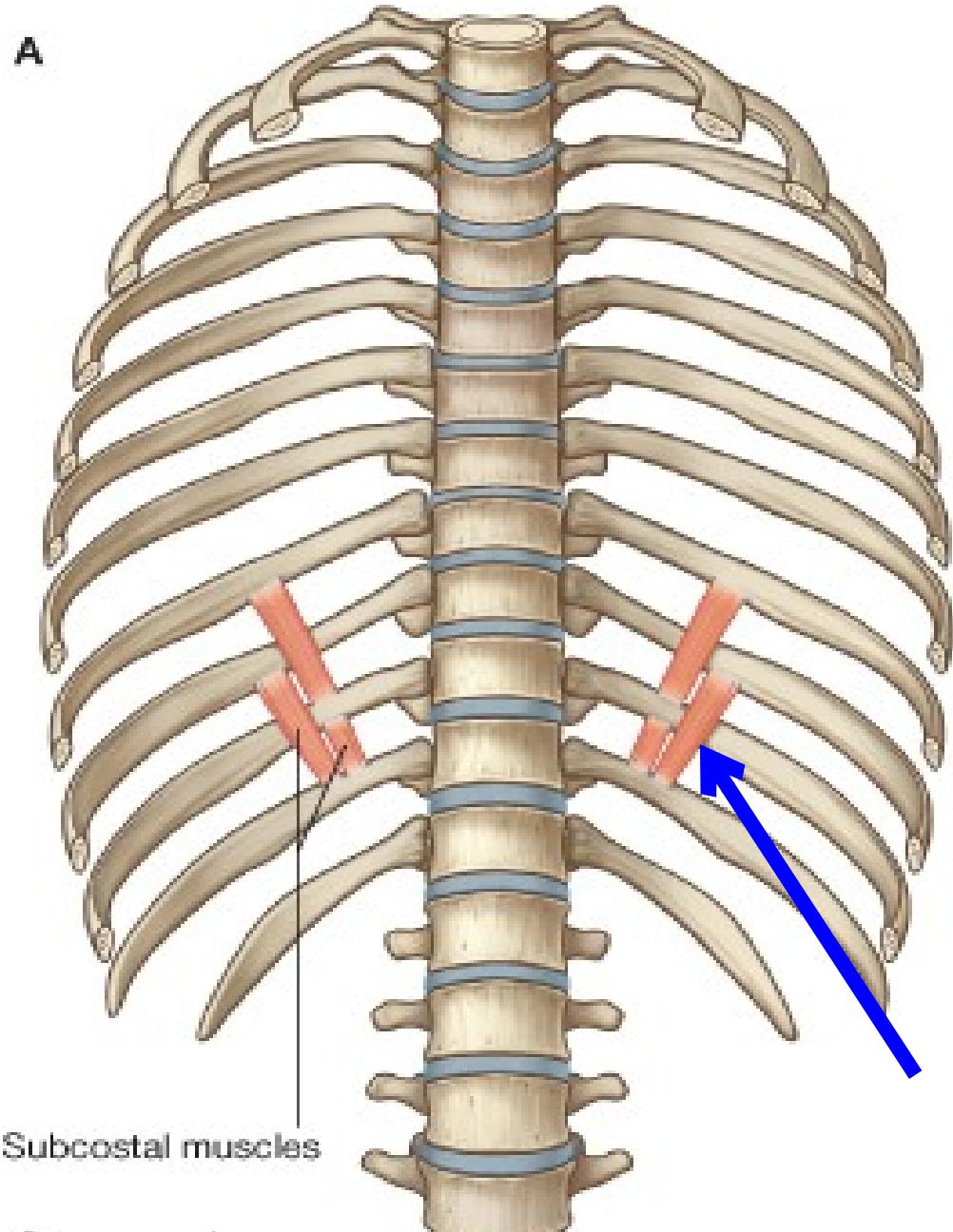
Internal intercos- tal

Innervo- st intercos- tal



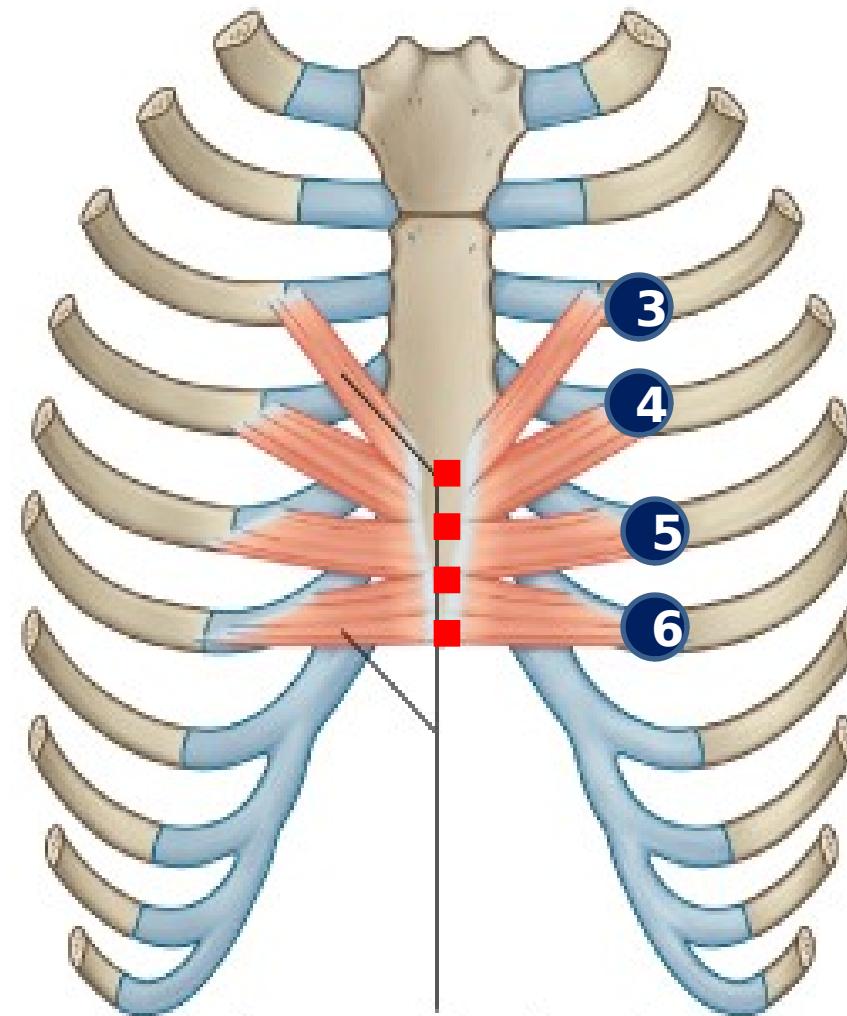
Subcostal muscle

- Thin sheets of muscle fibers on inner aspect of internal intercostal
- Arises from one rib & crosses 2 or more intercostal spaces to insert in a rib below
- Maybe absent



Transversus thoracis (sternocostalis)

- **Origin** □ lower third of back of sternum
- **Insertion** □ slips pass upwards & laterally to insert into 3rd to 6th CC



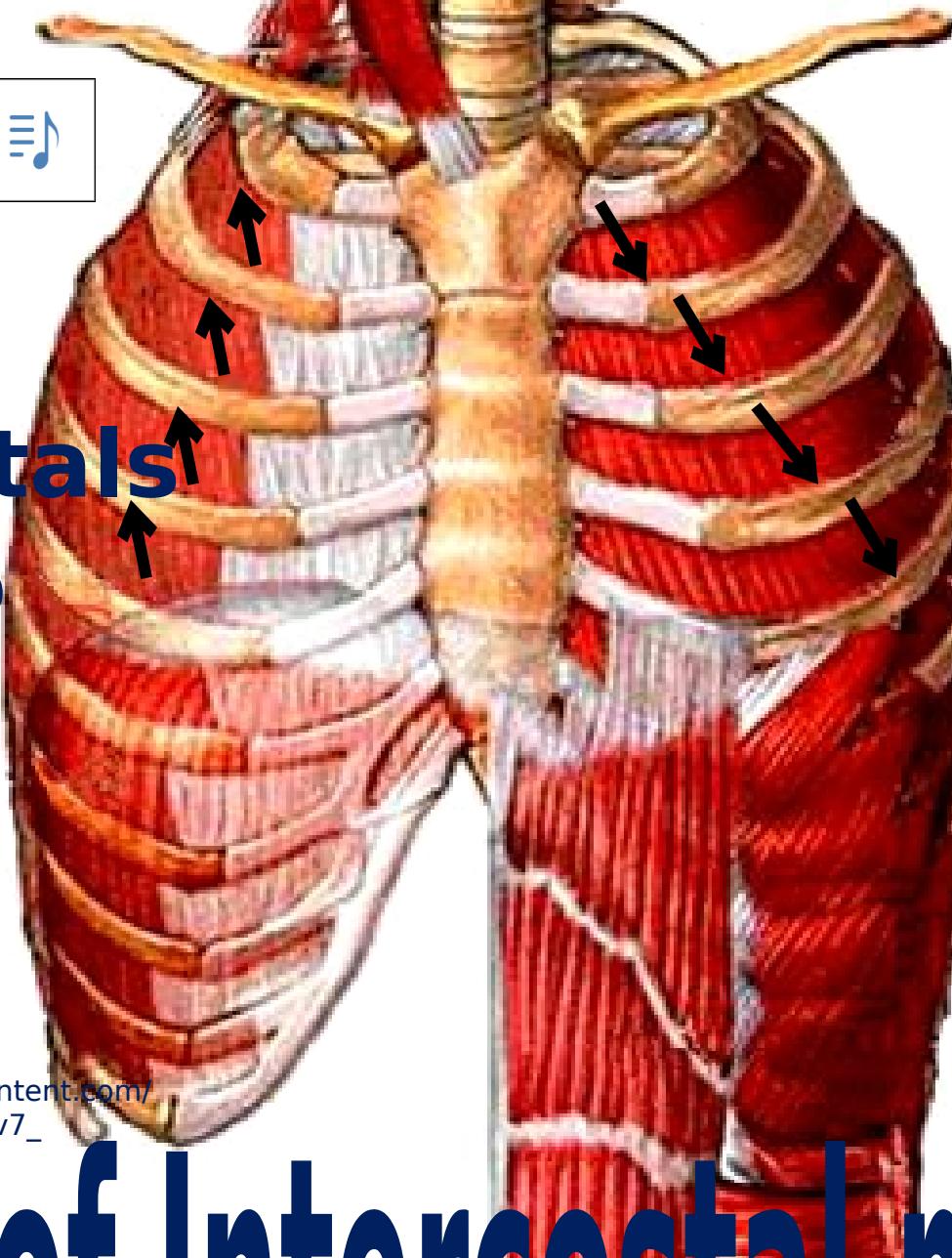
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<https://www.google.com.eg/search?sa=G&hl=en-EG&q=transversus+thoracis+function>

Innervation of Intercostal Muscles

- All are supplied by the corresponding **intercostal nerves**



 **External
intercostals**
**Elevato
rs
of the
ribs**



**Internal
intercost
als**
**Depress
ors
of the
ribs**

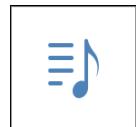
https://lh3.googleusercontent.com/_jycn0pVKphwyXGJ0Gt9v7_

Action of Intercostal muscles

Function of intercostal muscles:

preventing them from being drawn in or out during respiration

2. External intercostal is most active in inspiration (elevators of the ribs).



3. Internal intercostal & innermost intercostal ms are most active in expiration (depressors of the ribs).

4. Subcostal ms depresses the ribs.

Which of the following muscles is a rib elevator?

- a) External intercostal**
- b) Internal intercostal**
- c) Innermost intercostal**
- d) Sternocostal**
- e) Transversus thoracis**



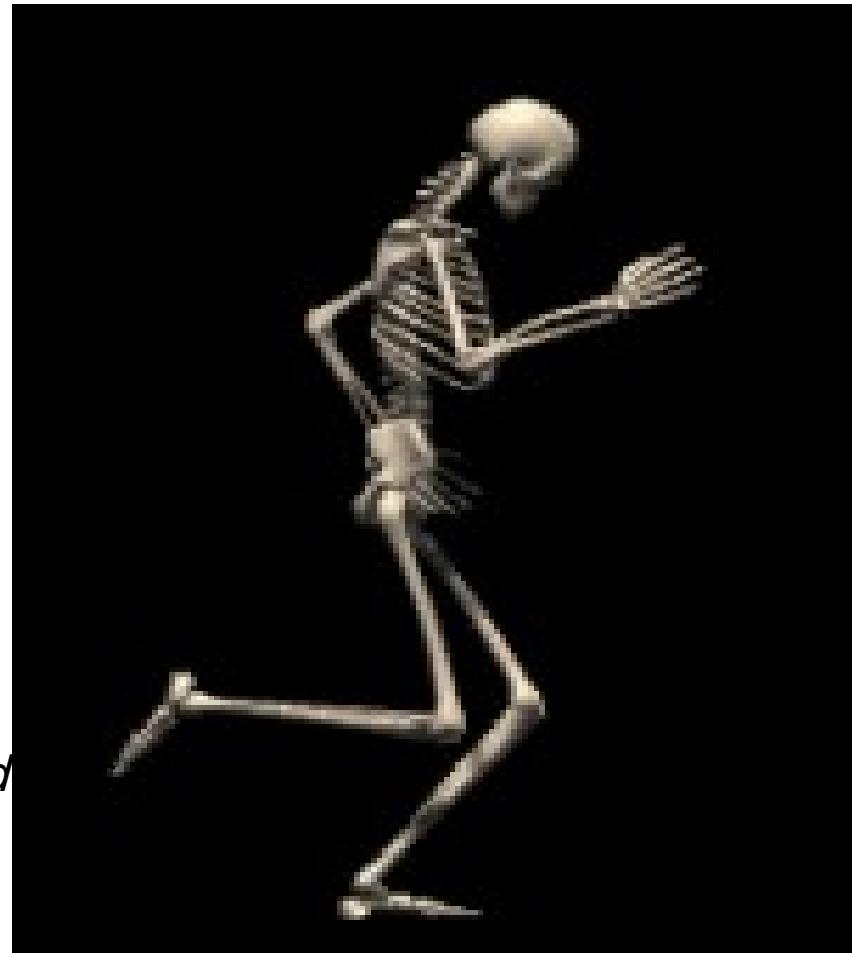
MCQ tests the actions of intercostal muscles.



THANK YOU



Suggested Textbook:
Clinical Anatomy for Medical Students
Richard S. Snell
Pages 63-70



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